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DESCRIPTION OF NEW RODENTS AND DISCUSSION OF THE ORIGIN OF DÆMONELIX.

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One of the field parties of the Carnegie Museum with the writer in charge was detailed by the Director to collect fossils in western Nebraska and eastern Wyoming during the season of 1904. In the collection which was secured are some very complete remains of rodents, belonging to two new species of *Steneofiber* not previously described. This material fully substantiates the views foreshadowed by Professor Scott, Dr. Matthew, and others, that this genus is clearly distinct from *Castor*. In the following detailed description of this new material it will be seen that there are some features, especially in the cranium, which are similar to those in the genus *Castor*, but these do not necessarily imply relationship. The skeleton as a whole shows osteological characters very similar to those of *Aplodontia rufa* with which I have compared it.[1] *Cynomys ludovicianus* is also used for comparison in studying the present fossil forms.

The material was discovered in the Upper Miocene sandstones, or Harrison (*Dæmonelix*) beds, in Sioux Co., northwestern Nebraska, and also in Converse Co., Wyoming, immediately across the Nebraska-Wyoming state line, and in the same general locality. Fossils are comparatively rare in this horizon. The list of genera found is as follows: *Promerycochœrus*, *? Mesoreodon*, a Peccary, *Oxydactylus*, and other small species of camels not identified. The commonest fossils from this horizon are the new species of rodents described in the following pages.

I take pleasure in acknowledging the valuable assistance of Mr. Earl Douglass

[1] A specimen of *Aplodontia rufa* (Col. U. S. Dept. Agri., No. 77975) was kindly furnished for comparison by Dr. C. H. Merriam, Smithsonian Institution, Washington, D. C.

in reading and correcting the manuscript and making kindly criticisms, of Mr. Sydney Prentice for making the drawings, of Mr. O. E. Jennings for working out the details in microscopic sections made from *Dæmonelix* and furnishing notes on his observations, of Mr. A. S. Coggeshall for photographs and of Mr. A. W. Vankirk for making the microscopic slides and assisting in cleaning up the material. To Director W. J. Holland is due special acknowledgment for the privilege of describing this interesting and complete material.

Steneofiber fossor spec. nov.

This species is quite common in the Harrison (*Dæmonelix*) beds in eastern Wyoming and western Nebraska. This horizon immediately overlies the Monroe Creek beds and is probably equivalent to the upper John Day. There are fourteen specimens of this species in the Carnegie Museum collections, which were found inside of as many *Dæmonelices*. In some cases nearly complete skeletons were discovered. The type (No. 1217) was found near the rounded end of a "rhizome," and consists of the cranium, the vertebral column, including eleven caudals, (the extreme tip of the tail is missing), both clavicles, and a fairly complete set of ribs. The right and left fore limbs are complete, except the superior part of the right scapula and the feet. The pelvis and the posterior limbs are present, including the greater part of the right pes. No. 1208 is used as a cotype, and has the skull, lower jaws, eleven presacral vertebræ, the sacrum, both clavicles, the manubrium, and several ribs. The fore limbs are fairly well represented, and there are some fragments of the hind limbs. In the following description of the osteology of *S. fossor* use will be made of supplementary material, when, by so doing, additional light is thrown on the subject. In each instance the museum catalogue numbers will be referred to in connection with the specimens.

The Superior Dentition.

The superior incisors are comparatively as large and strong as those of the recent beaver; anteriorly the broad and flat surface is covered with a heavy coating of enamel, which forms rather sharp angular edges laterally. The rounded lateral and posterior faces have no enamel. The antero-posterior diameter is as great as the transverse. The chisel-shaped gnawing portions of the teeth are long and terminate anteriorly in a broad sharp edge.

The superior grinding teeth are rather small in comparison with the size of the skull. They gradually decrease in size from p^4 to m^3. Their position is nearly parallel with the long axis of the skull, and they are placed about midway between the anterior and posterior extremities of the skull.

$P^{\underline{4}}$ is the only superior cheek-tooth that retains the internal enamel-fold after the maturity of the animal. All the other teeth seem to have lost this character early, the surrounding enamel-bands showing no folding.

In the cotype (Pl. XVII., Fig. 3) there is a slight dissimilarity in the enamel pattern of the crowns of the premolars on opposite sides. The anterior fossette of the right premolar is oblong, and is the continuation of the internal enamel-fold, while on the tooth on the left side this fossette is smaller and rounded, and the anterior island is apparently independent of the internal enamel-fold. On the external enamel-band there remains a slight indication of the folding, which is shown only in the cotype in our series of skulls. There is also a small rounded fossette near the postero-external angle on both premolars, a character not found in the type.

Molar $\underline{1}$ is broader than long in the cotype, while in the type its diameter is nearly equal in both directions giving it a subcylindrical form. There are three fossettes on the grinding face, one antero-external and transverse, the other antero-

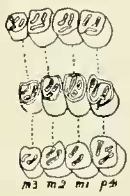


FIG. 1. Crown view of superior grinders of *Steneofiber fossor* representing different stages of wear. *a*, type, No. 1217; *b*, cotype, No. 1208; *c*, an old individual, No. 1207. Figures natural size.

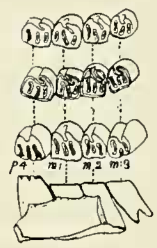


FIG. 2. Crown view of inferior grinders of *Steneofiber fossor*. *a*, type, No. 1217; *b*, cotype, No. 1208; *c*, an individual showing $p_{\overline{4}}$ in a nearly unworn stage; *d*, internal view of same specimen as *c*, No. 453. Figures natural size.

internal and oblique, while the third is a large fossette occupying an oblique position on the postero-external part of the tooth.

Molars $\underline{2}$ and $\underline{3}$. So far as the numbers and positions of the fossettes on molars $\underline{2}$ and $\underline{3}$ are concerned they are like the premolars. The last molar in the type is smaller than in any of the other skulls in the Carnegie Museum series.

THE INFERIOR DENTITION.

The inferior incisor is as large and as strong as the superior, and is similar to that of the recent beaver, excepting that in our fossil form, the anterior face of the tooth is flat. This is characteristic throughout the entire series. The left premolar is injured in the type, but the corresponding tooth on the right side is complete The anterior fossette is still connected with the enamel band, while that on the opposite tooth is free. This tooth ($p_{\overline{4}}$) has the three transverse fossettes and the external folding of the enamel usually seen in this genus. In *S. fossor* the folding of the enamel is somewhat similar in position, although not so deep as that in *S. montanus*. In *S. fossor* the tooth has a slightly greater antero-posterior diameter than $m_{\overline{1}}$. It has rounded anterior and posterior faces.

Molar 1. — With exception of the less rounded anterior face, and the deeper and more oblique external enamel-folding, this tooth is like the one in advance of it. In width and length the tooth has the same diameter.

Molar 2.—This tooth is similar to $M_{\overline{1}}$ with a slightly less transvere diameter. On the tooth in the left ramus the posterior fossette is divided in two portions, while that of the opposite tooth is undivided.

Molar 3. — The characters of the third molar are essentially those of the preceding molars 1 and 2. The tooth is smaller than those in advance of it. The teeth are quite prismatic, and terminate in short peg-like roots.

The Skull. Plate XVII., figs. 1, 2, 3.

The skull of *S. fossor* is comparatively large, with a rather low occiput, a low sagittal crest, moderately long muzzle, and broad zygomatic arches. In general outline the skull has a closer resemblance to that of *Aplodontia rufa*[1] than to any other recent rodent. In studying the skull in detail there are many striking differences between this and the recent genera. The nasals extend comparatively farther back than in *Aplodontia* or *Cynomys*, so that the fronto-premaxillary suture is more sinuous across the face and top of the skull than in these genera. Anteriorly the nasals terminate rather bluntly, not overhanging the premaxillaries. The lateral border of the nasal is supported entirely by the premaxillary, as in *Aplodontia*. They are broad and flat anteriorly, forming the roof of a triangular anterior narial opening.

The frontals are short, broad anteriorly, with a greatly constricted interorbital region. They terminate posteriorly in a wedge-shaped connection with the parietals. The supraorbital rugosity is quite heavy in some individuals of this species, and the temporal ridges take their origin at this swelling and rapidly unite opposite the interorbital constriction. There is no postorbital process on the frontal. In this respect the fossil is similar to *Aplodontia*.

In *S. fossor* the postorbital area of the frontal is more rounded than in *Aplodontia*, and the postorbital constriction is greater. There is a distinct sagittal crest in the type.

[1] The generic name first proposed in 1829 by Richardson was *Aplodontia*, and, while not satisfactory to a purist in Greek etymology, has priority, and must stand.—*Editor*.

The parietals extend well forward and overlap the posterior part of the frontals. Laterally, they unite with the squamosals by a suture, which runs antero-posteriorly in a parallel line with the long axis of the skull. Posteriorly the parietals are wing-shaped, on account of the large triangular interparietals. From the base of the sagittal crest each parietal is gently convex laterally. At the squamosal suture there is a slight swelling, the temporal region of the squamosal being more abruptly convex towards the zygomatic process than is the case in *Aplodontia*. The brain case is rather flat, but rapidly expands back of the supraorbital constriction.

The interparietal is large, and is like that of the recent beaver. In this region the skull bears a great resemblance to that of *Castor*, with a comparatively broader occiput, and straighter lambdoid crest. Posteriorly, the interparietals are broad, and they taper rapidly to an anterior point, thus occupying the V-shaped space in the postero-superior border of the parietals.

The occipital surface is almost vertical, as in *Cynomys*, but is much broader than in this genus. The supraoccipital occupies the greater portion of this area, as the mastoid is but slightly inflated. The entire surface superior to the foramen magnum is a vertical plane, and terminates superiorly in the lambdoid crest. Inferiorly there is a shallow emargination, which forms the superior border of the foramen magnum. At the point of contact with the exoccipitals in the lateral margin of the foramen magnum the suture extends outward and upward, and continues in an almost straight line to the junction of the mastoid and the posterior process of the squamosal. The sharp lambdoid crest takes its origin a little below this point, and continues in a gently curved line to the sagittal crest.

The occipital condyles are of moderate size and are not greatly separated by the emargination on the posterior face of the basioccipital. The paraoccipital process is small and points directly downward, terminating in a less truncated end than in the beaver. It is more nearly like that of *Aplodontia*. The occipital condyle is close to the otic bulla. The mastoid portion of the temporal bone is very little inflated. The mastoid process is broad laterally, and compressed antero-posteriorly, extending proportionally as low as that of *Castor*. It unites with the strong mastoid process of the squamosal, and is also fused together with the large external auditory meatus. This opening is somewhat like that of the beaver, the latter having a greater constriction just back of the opening of the tube. The whole region back of the zygomatic arches is short in *S. fossor*, and has a general resemblance to this region in *Aplodontia*. The tympanic bulla is inflated, flask-like, with a constricted but rather large tube, which is directed outward and upward, not horizontally outward as in *Aplodontia.* The position of the tympanic bulla is a character which very strongly recalls that of the recent beaver.

In the type (No. 1217) the base of the skull is damaged, but the cotype (No. 1208) supplements this region admirably. The basioccipital is entirely unlike that of the beaver, and is more nearly like that seen in *Aplodontia* and *Cynomys.* Anteriorly the basioccipital extends to opposite the anterior border of the otic bulla, in the type. In this region the inferior face has a slight shallow groove with two faintly indicated lateral ridges. These ridges meet 4 mm. back of the suture, and form a convex elevation, which increases in width posteriorly. In the beaver nearly the entire length and width of the basioccipital is deeply excavated inferiorly, which is a constant character. The presphenoid of the fossil is apparently similar to that of *Castor.*

The pterygoids are prominent and terminate in backward projecting alæ, which touch the otic bullæ. Superiorly, these hamular processes are emarginated, so as to form a large, oblong foramen, which leads into the large pterygoid fossa. The outer process bounding the pterygoid fossa extends back to the antero-external face of the otic bulla, and unites firmly with the floor of the brain case. The foramen ovale pierces this outer process of the pterygoid near the extreme inferior border. The alisphenoid cannot be outlined in either the type or cotype of this species. In skull No. 1212, however, the suture can be partly traced. The bone appears to be of large size, and similar to that of the beaver. The posterior wing extends to the tympanic, and forms a suture with it. The squamosal suture is immediately below the lower border of the glenoid cavity, and extends anteriorly in a sinuous line. The extreme anterior point cannot be ascertained, but may reach to the posterior border of the orbit. There is an alisphenoid canal.

The squamosal occupies relatively a greater area superiorly, than in the beaver. It has also a larger posterior portion, which joins the supraoccipital directly. In the beaver the parietal has a descending lobe postero-laterally, which unites with the mastoid portion of the squamosal. The squamosal is thus separated from the supraoccipital by this descending lobe in *Castor.* Anteriorly the squamosal extends relatively farther forward in *S. fossor* than in the beaver. The zygomatic process of the squamosal is similar in size, shape, and position to that of *Castor fiber.* Posterior to and continuous with the base of this process is a prominent and sharp border, like that in *S. peninsulatus,* which according to Cope, enlarges the postglenoid fossa more than in either *C. fiber* Linnaeus or *S. Eseri* v. Meyer (*S. viciacensis* Gervais). There is a subsquamosal foramen present in the type. The glenoid cavity is an antero-posteriorly elongated and laterally convex surface. The antero-posterior diameter is relatively greater than that of the beaver. The skull is broadest across the zygomatic processes of the squamosals.

The jugal is the most prominent bone in the zygomatic arch. The anterior process does not reach the lachrymal, and is proportionally shorter than in the beavers. There is a strong postorbital angle, similar to that in *Castor fiber*, *S. viciacensis* (see Cope, Tertiary Vertebrata, p. 841), and *S. peninsulatus*. The anterior part of the jugal, across the postorbital process to the inferior margin of the arch, is the widest surface of the bone. From this point backward, the jugal decreases rapidly, and terminates in a somewhat enlarged end, which forms the exterior border of the glenoid cavity. As a whole the zygomatic arch is proportionally wider and stronger than that of *Castor*, but otherwise is very similar.

The palatine plate of the maxillary extends posteriorly to the line between m^1 and m^2, and anteriorly to the posterior margin of the incisive foramina. In the beaver, the palatine plate of the maxilla is shorter posteriorly. In the type the posterior narial opening is well back of m^3, and the front part of the palatine plate is much more concave than in *Castor*. Anterior to the alveolar border is a prominent ridge, extending from p^4 in a curved line on the side of the muzzle, terminating abruptly below and in front of the infraorbital foramen. In the beaver, this ridge is not so prominently extended to p^4; it is heaviest at the infraorbital foramen, and continues obliquely upward, across the maxillo-premaxillary suture nearly to the top of the skull, and unites with the malo-maxillary ridge forming a deep trough-like fissure for the masseter muscle. In *S. fossor* the malo-maxillary ridge extends forward only a short distance and does not join the upward extended ridge mentioned in the skull of *Castor*. In the type (No. 1217), the infraorbital foramen is small, which is characteristic of the genus. The zygomatic process of the maxillary is very strong, vertically broad, and ends abruptly at the inferior jugo-maxillary suture.

The lachrymal cannot be outlined in the type or cotype. In skull, No. 1207, however, this bone forms an extremely small part of the facial region. The bone is very small, perhaps even comparatively smaller than in the beaver, and, as in that genus, is located immediately internal to the opening of the lachrymal foramen.

The premaxillary is rather heavy to support the very large and powerful incisors. Below, it is laterally convex, with a median ridge extending from the incisive alveolar border to the anterior edge of the incisive foramen. The latter is relatively broader than in *Castor*. The maxillo-premaxillary suture in *S. fossor*, may be traced from the posterior border of the incisive foramen in a slightly curved line to the root of the zygomatic process, thence obliquely back to meet the fronto-nasal suture.

There is a strong swelling on the side of the muzzle, plainly indicating the direction of the root of the incisor. The muzzle is broadest across this swelling. The naso-premaxillary suture converges backward, making the nasals narrower posteriorly than anteriorly.

The Mandible. Plate XVII., figs. 1, 4.

The lower jaws are very heavy. The ascending ramus occupies more than half of the entire length of the mandible. The coronoid process takes its origin on the exterior side of the ramus, opposite the posterior part of $p_{\overline{4}}$; thence ascending in a gentle backward slope to near the summit, which is rapidly curved posteriorly, and terminates in a thin, rounded, and transversely compressed point. There is relatively a deeper and larger fossa separating the alveolar border from the coronoid process than in the beaver. In the fossil, the alveolar border is abruptly elevated above the diastema in front. Anteriorly, the jaws are united by a strong symphysis. On the chin is a strong process, similar to that in the beaver. The external face of the ramus is irregularly convex, the internal somewhat concave below the molar series. The angle is greatly deflected outward, and the inferior portion descends more below the border of the horizontal ramus than it does in the beaver. In *S. fossor* this angle terminates in a strong postero-lateral process. This process is very similar to that in *Aplodontia*, with somewhat less inferior and exterior development.

The alveolus of the incisor terminates posteriorly in a heavy, rounded protuberance on the external face of the ascending ramus below the condyle, similar to what is seen in *S. peninsulatus*. The deep fossa above this protuberance is similar in the two species, so far as can be judged from the type of *S. peninsulatus*. The form of the condyle also agrees with Cope's description: it "is subglobular, and has considerable more external than internal articular surface" (Tertiary Vertebrata).

With the exception of the less developed inferior process on the chin, the apparently more rounded anterior face of the incisor, the comparatively heavier femur and much longer tibia, the type of *S. peninsulatus* agrees closely with *S. fossor*. The skull, which Cope associates with the lower jaw, and the hind limbs of *S. peninsulatus*, figured on Plate 63, figs. 18, 18*a*, 18*b* (Tertiary Vertebrata), is distinctly different from *S. fossor* in having less expansion across the zygomatic arches, and possessing apparently a much shorter tube on the otic bulla, and a somewhat longer muzzle.

The skull figured and described as *S. pansus* (Bull. Am. Mus. Nat. Hist., Vol.

XX., pp. 257–270, 1904) has the same general shape as the skull of *S. fossor*, but the latter differs in having a relatively greater interorbital constriction; the diastema in front of the cheek-teeth is more highly arched; the palate is longer, and the basioccipital is not excavated. In *S. fossor* the ascending ramus of the mandible is not so vertical as that of *S. pansus*.

Measurements.

Skull.

	Type.		Cotype.	
Greatest length	74	mm.	76	mm.
Greatest width	60	"	62	"
Greatest height, measured at m^3 to top of anterior part of sagittal crest	30	"		
Greatest width of occiput at external auditory meatus	48	"	48	"
Greatest width of muzzle anteriorly	12	"	15	"
Width of interorbital constriction	10	"		
Length of nasal	22	"		
Length of sagittal crest from union of temporal ridges to occiput	28	"		
Height of occiput	22	"		
Antero posterior diameter of otic bulla	13	"	13	"
Transverse diameter including tube and external auditory meatus			24	"
Extreme width of occipital condyles			16	"
Space between incisors and p^4	27	"	30	"
Space from m^3 to and including condyle			28	"
Width of palate at p^4	4	"	4	"
Width of palate at m^3			6	"

Superior Dentition.

Length of incisor from the alveolar border to the cutting point	21	"	21	"
Antero-posterior diameter of incisor	5	"	5	"
Transverse diameter of incisor	5	"	5	"
Antero-posterior diameter of grinding teeth	14	"	14	"
Antero-posterior diameter of p^4	4	"	4	"
Transverse diameter of p^4	4	"	4	"
Antero-posterior diameter of m^1	3	"	3	"
Transverse diameter of m^1	4	"	4	"
Antero-posterior diameter of m^2	3	"	3	"
Transverse diameter of m^2	3.5	"	3.5	"
Antero-posterior diameter of m^3	2.5	"	3	"
Transverse diameter of m^3	2.5	"	3	"

Mandible.

Greatest length of mandible including incisor	59	"	64	"
Length of mandible from process on angle to incisor—alveolar border	50	"	54	"
Greatest depth from angle to top of coronoid process	31	"		
Depth at diastema	10.5	"	12	"
	14.5	"	16	"
Height of coronoid process	9.5	"	9.5	"
Antero-posterior diameter of condyle	6	"	6	"

Transverse diameter of condyle	5 mm.	5 mm.
Length of diastema	16 "	16 "

Inferior Dentition.

Length of incisor from alveolar border to cutting point	25 "	27 "
Antero posterior diameter of incisor	5 "	6 "
Transverse diameter of incisor	4.5 "	4.5 "
Antero posterior diameter of grinding series	16 "	16 "
Antero-posterior diameter of $p_{\overline{4}}$	4.5 "	4.5 "
Transverse diameter of $p_{\overline{4}}$	4 "	4 "
Antero-posterior diameter of $m_{\overline{1}}$	4 "	4 "
Transverse diameter of $m_{\overline{1}}$	4 "	4 "
Antero-posterior diameter of $m_{\overline{2}}$	3.5 "	3 5 "
Transverse diameter of $m_{\overline{2}}$	4 "	4 "
Antero-posterior diameter of $m_{\overline{3}}$	3 "	3.5 "
Transverse diameter of $m_{\overline{3}}$	3.5 "	3 5 "

Vertebral Formula. Plate XIX.

There were found, with the type (No. 1217), twenty-six presacral vertebræ, the sacrum, and eleven caudals. The vertebral column was not interlocked, vertebra with vertebra, when found, but it seems reasonable, that the following formula may be correct: seven cervicals, thirteen dorsals, six lumbars, five sacrals, and eighteen caudals, assuming that the last seven vertebræ are lost from the type. There are probably not more than seven or eight missing, to judge from the gradual tapering of the anterior caudal vertebræ, which were found in position and continuous with the posterior sacral vertebræ.

The Atlas. — The antero-posterior diameter of the atlas is smaller than that of *Aplodontia.* This is especially true of the superior arch. The inferior arch is a little heavier than in the latter genus. The articulation for the occipital condyle is very similar to that of *Aplodontia;* it is not very deep, and occupies, perhaps, more of the area of the anterior face of the atlas than is seen in *Aplodontia.* The foramen for the spinal nerve enters the superior arch internally, immediately above the cotylus, then pierces the arch to the superior face, and again reënters it in a postero-lateral direction. There are two posterior openings, one at the base of the transverse process on the lower side, and the other in the deep fissure above the articulation for the axis and at the base of the transverse process on the upper side. The foramen is similar to that of *Aplodontia,* but relatively smaller. In the type, the transverse process is complete, and is remarkable for its short and heavy character. The general aspect of the whole bone is similar to that of *Aplodontia.*

The Axis. — The axis is rather heavy, and is conspicuous on account of the high, strong, and antero-posteriorly broad neural spine, which overhangs the neural canal in front. Posteriorly, the neural arch overhangs the superior part of the short spinous process of the third cervical, so that the anterior part of the arch of the latter is entirely within the arch of the axis. In the cotype (No. 1208), the third cervical is entirely coössified with the axis (Pl. XVIII., Figs. 9, 9*a* and 9*b*.) The articulation for the atlas is extended well up upon the anterior border of the neural canal. The odontoid process is a heavy rounded peg. The delicate transverse processes are broken off on the axis and the third cervical.

The Third Cervical. — The third cervical is charactistic in *S. fossor*, on account of its tendency to become coössified with the axis. In the type, this vertebra is clearly separated from the axis, but the encroachment of the latter bone on the third cervical shows that in old individuals these two vertebræ may become coössified. In the type the neural spine is not so high as in *Aplodontia*, and the centrum has the same antero-posterior diameter as in that genus.

The Fourth Cervical. — This vertebra is represented by the centrum and half of the neural arch in the type specimen. The centrum is short antero-posteriorly, even shorter than the centrum of the third. Transversely, the centra are broad, and depressed vertically. The fourth cervical appears to have a heavier transverse process than in *Aplodontia*.

The Fifth Cervical. — The fifth cervical is almost identical in form with the fourth. The neural arch and spine are somewhat heavier than in *Aplodontia*, and the transverse processes appear stronger. The neural canal is large. The vertebrarterial canal is smaller than in *Aplodontia* and *Cynomys*. The prezygapophyses are directed forward and downward, and postzygapophyses upward and backward.

The Sixth Cervical. — The neural arch is injured, and the transverse processes of this vertebra are lost. The antero-posterior diameter of the centrum is less than in the preceding vertebra; otherwise there is not any marked difference between these two bones.

The Seventh Cervical. — The neural arch is low and broad, similar to that in *Aplodontia*, but heavier. The spine appears shorter. The antero-posterior diameter of the centrum is but very little greater than that of the preceding vertebræ. The transverse processes are heavy, and are directed horizontally outward from the centrum, not postero-laterally as is the case in all the preceding vertebræ. There is a distinct facet for the first rib on the posterior face of the centrum. This vertebra has no vertebrarterial canal.

As a whole, the cervical region is comparatively short and broad. With exception of the shape of the third cervical, the neck is similar to that of *Aplodontia*.

Dorsal Vertebræ. — There are thirteen dorsals more or less complete in the type specimen. The vertebra succeeding the thirteenth dorsal may or may not have supported a rib. This vertebra has no distinct transverse processes, and there are no visible facets for the ribs on the sides of the centrum. In view of the fact that *Cynomys* has apparently no distinct transverse processes on the first lumbar, I shall, in this description, regard the vertebra under discussion as the first lumbar.

The First Dorsal. — This vertebra has a less robust spine than is seen in *Aplodontia*, otherwise the neural arch is relatively as strong as in that genus. The short centrum has a plane surface inferiorly. The transverse processes are rather short and heavy, with a broad support for the tuberculum of the first ribs. The prezygapophyses are, as usual, placed low down on the arches, at the base of the transverse processes, while the postzygapophyses are higher up on the arch, in order to meet the articular surface of the succeeding vertebra.

The Second Dorsal. — This vertebra is complete with the exception of the tip of the neural spine. The latter is crushed to one side, which gives it a somewhat shorter appearance than the spine of the succeeding vertebra. The centrum is but slightly concave antero-posteriorly, and its diameter is very little greater than that of the first dorsal. The transverse process is strong, with a large tubercular facet for the second rib. The prezygapophysis is even lower down on the anterior border of the arch, than in the preceding vertebra, and does not extend so far beyond the arch anteriorly as in *Aplodontia* and *Cynomys*. The postzygapophysis is large and overhanging.

The Third Dorsal. — With the exception of a longer and somewhat stronger neural spine, and the shorter transverse process this vertebra is very similar to the one in advance of it.

The Fourth Dorsal. — The fourth dorsal is complete, except the top of the neural spine. The centra in this portion of the dorsal region gradually increase in length proceeding backwards; they decrease in their transverse diameter, increase in the vertical dimension, and acquire a more concave surface inferiorly. The fourth dorsal has strong transverse processes, which point outward and upward from their base. The rib contact is strong.

The Fifth, Sixth, Seventh, Eighth and Ninth dorsals are so similar that the description of one will answer for the entire series.

The neural spines gradually become lower, the transverse processes shorter, and the antero-posterior diameters of the centra greater. The inferior surface of the centrum is more convex fore and aft in the eighth and ninth than in any of the preceding dorsals. In these vertebræ, and the one in advance of them, the neural spines have lost their rounded form and gradually become laterally compressed. The tips of the neural spines of the sixth and seventh dorsals are broken off.

The Tenth Dorsal. — In the type, this vertebra is only represented by the neural spine, the prezygapophyses, and a small portion of the anterior part of the arch. This vertebra has the most delicate spine in the dorsal series.

The Eleventh Dorsal. — The eleventh dorsal is distinctly different from the preceding dorsals. This difference is chiefly found in the lateral convexity of the postzygapophyses, and in the presence of well developed metapophyses. The transverse process is only a small rounded knob, situated immediately below the base of the metapophysis on the exterior face of the pedicle. The spine of this vertebra is much higher than on the corresponding vertebra in either *Aplodontia* or *Cynomys.*

The Twelfth Dorsal. — There is no transverse process on this vertebra. The metapophysis is broken off. The neural spine is heavier, but is not so high as in the preceding vertebra. The postzygapophysis is more rounded than in the eleventh dorsal, and its articular face is directed more outward than downward. The centrum is less depressed than in the preceding vertebræ.

The Thirteenth Dorsal. — The right prezygapophysis and metapophysis are broken off from this vertebra in the type. The top of the neural spine is also injured. The centrum is much concave fore and aft, and is very little longer than that of the preceding vertebra. The large postzygapophysial articulation faces downward and outward, but is not as convex as that of the eleventh and twelfth dorsals. The strong metapophysis takes its origin at the base of the prezygapophysis on the superior part of the pedicle and terminates in a rounded point in a parallel line with the postzygapophysis. Its size, shape, and position are very similar to those of *Aplodontia* and the prairie-dog.

The change of direction of the neural spine occurs in the tenth dorsal in *Cynomys,* while this change of position is only slightly noticeable in the tenth and eleventh dorsals of *Aplodontia.* In *Stenеofiber fossor* the change of direction of the neural spine is gradual, similar to that in *Aplodontia,* but it takes place in the twelfth and thirteenth dorsal (as in *Castor*), instead of the eleventh and twelfth. *S. fossor* also differs from *Aplodontia* and *Cynomys* in having higher spines on the posterior portion of the dorsal region.

The Lumbar Vertebræ. — The three anterior lumbars and the thirteenth dorsal were found articulated with one another by their zygapophyses. These vertebræ are complete except some of the delicate processes. As a whole, the lumbar region in *S. fossor* is more nearly similar to that of *Aplodontia* than to that of *Cynomys* or *Castor.*

The First Lumbar. — The first lumbar vertebra is decidedly heavier than the last dorsal. It is further characterized by the sudden increase of the antero-posterior diameter of the neural spine. If the last dorsal and the first lumbar had not been found in position, I would have been inclined to think that there might be a vertebra missing at this point. This vertebra resembles the preceding in not having a transverse process. Otherwise this bone is very similar to the following vertebra, which has all the characteristic features met with in this region. The inferior surface of the centrum is slightly keeled, and has a greater diameter antero-posteriorly than the last dorsal. The prezygapophysial articulation is a large surface, and is slightly concave.

The Second, Third, and Fourth Lumbars are so similar to one another that the description of one will answer for all. The antero-posterior diameter of the centra gradually increases; their inferior faces are more keeled; and the transverse processes become longer from the second to the fifth lumbar. The fourth lumbar has apparently no metapophysis. In this respect it is similar to the same vertebra in *Aplodontia.* The transverse processes are short and heavy, and are located on the pedicle, and not directly in contact with the centrum as in *Cynomys.* In *Castor,* these processes are high, but not as high comparatively as in *S. fossor* and *Aplodontia.*

The Fifth Lumbar. — This vertebra is represented by the complete neural arch, the centrum having apparently become absorbed by plants that are so common inside of *Dæmonelix.* The most characteristic feature of this vertebra is the sudden decrease of the neural spine. This is more apparent than in either *Cynomys* or *Aplodontia.* The transverse process is present on the left side, and is situated on a horizontal line with the postzygapophysis.

The Sixth Lumbar. — In the type, the left postzygapophysis and the end of the right transverse process are missing from this vertebra. The centrum has a greater antero-posterior diameter, and is more keeled than in any other presacral. The transverse process is prominent, and situated high as in the preceding lumbars. The neural spine is somewhat more reduced than that in *Aplodontia.* Otherwise this vertebra is very similar in these two genera.

The Sacrum. — There are five well coössified centra in the sacrum of *S. fossor.* In *Aplodontia* there are six, in a young *Cynomys* three, and in *Castor* four. In the cotype (No. 1208) there are five lumbar vertebræ and a sacrum; the last sacral is lost, but the centrum and the pleurapophyses on the preceding vertebra show, that there was coössification between the fourth and fifth sacrals. The number of sacral vertebræ in *S. fossor* consequently seems to be five, at least in two distinct cases. The centrum of the anterior sacral vertebra in the type (No. 1217) is very nearly as heavy as that in the last lumbar. The centra of the posterior sacrals rapidly decrease in size, corresponding to the moderately long tail.

The ilium is supported by the strong pleurapophyses of the three anterior sacrals. In the type specimen, the neural spines are all separated in a way similar to those in *Cynomys*. In the cotype, however, the first and second spines are coössified. In *Aplodontia*, the whole series back of the first spine is coalesced into a thin plate of bone, directed antero-posteriorly as also seems to be the case in *Castor*. In the type of *S. fossor*, the neural spine of the third sacral vertebra was injured during the process of cleaning up the specimen; but the remains indicate, that it was perhaps the heaviest spine in the sacrum. The spinous processes on the two last sacrals are short, stout, and terminate in an enlarged rounded knob.

The sacrum as a whole presents the aspect of a narrow, long, and vertically deep column of bones. In *Aplodontia*, the sacrum is of approximately the same length, but has much less vertical depth, and decreases more rapidly toward the posterior end, than in *S. fossor*. The "Sewellel" has a remarkably short caudal region, while *S. fossor* has one about the length of that of *Cynomys*.

The Caudals. — As has been stated above, the tail of the type specimen consists of eleven anterior caudals. There were seven in a continuous series and in connection with the sacrum. The four remaining vertebræ are of about the right size to continue the series from seven to twelve. Assuming that the caudal series in *S. fossor* is similar to that of *Cynomys*, there would then be seven or eight vertebræ missing at the end of the tail.

The caudal region of *S. fossor* is heavier than in *Cynomys*, but in form it rather resembles the latter genus than *Castor* or *Aplodontia*. In the type the centra are short, round, and heavy. There is no neural canal back of the fourth caudal. The antero-posterior diameter is nearly equal in the first and last caudal vertebræ in the specimen under discussion. In the five anterior caudals there are distinct transverse processes. In *Cynomys*, these processes can be traced back to the ninth caudal, while in *Castor* they continue to the end of the tail. From the sixth caudal to the tenth, there are small protuberances on the inferior faces of the vertebræ, which may or may not have supported chevrons. In the Trans. Amer. Philos. Soc., vol. 17, 1893, p. 77, Professor Scott states that the anterior portion of the caudal region was provided with chevrons in *S. montanus*. The caudal vertebræ present in the type (No. 1217) indicate a heavy, moderately long, and round tail.

The Ribs. — *Steneofiber fossor* probably had thirteen pairs of ribs. *Cynomys* has twelve, *Aplodontia* fourteen, and *Castor canadensis* fifteen.

In the type specimen, there is a fairly complete set of ribs. The first is much flattened, expanded distally, and provided with a strong contact for the cartilaginous rib of the sternum. The shaft of the rib decreases in width superiorly, and is nearly round immediately below the heavy tuberculum. The head is rather small and rounded. The rib as a whole is different, especially distally, from that of *Cynomys* and *Aplodontia*. The latter genera have the lower end of the rib more rounded in cross section.

The ribs of the anterior half of the thorax are flat proximally, and rod-like distally. In the meso-thorax, and more posteriorly, they are rod-like throughout.

The Clavicle. — The clavicle in *S. fossor* is heavier than in either *Cynomys* or *Aplodontia*. In the cotype (No. 1208) both clavicles and the manubrium are present. The latter is much heavier than in *Aplodontia* or *Cynomys*. Anteriorly, there is a broad, gently rounded surface for the attachment of the clavicles. The attachments for the first set of ribs are very large, and are located close to the anterior end of the bone. Back of this rib-attachment is a long and gentle lateral constriction. Inferiorly, the bone is slightly keeled ; supero-anteriorly it is concave. Posteriorly it expands above and on the sides, indicating a rather large mesosternum.

Both clavicles in the type are complete, and are not so robust as those of the cotype. The latter specimen represents a somewhat larger and more robust individual. In shape, the clavicle is very similar to that of the beaver. The sternal attachment is more enlarged than in *Cynomys* and *Aplodontia*. The curve of the shaft in *S. fossor* is similar to that in *Aplodontia* and *Castor*. The superior end is less flattened than it is in the beaver and the prairie-dog, and does not terminate in an enlarged head as in *Aplodontia*. The clavicle of *S. fossor* gradually tapers from the large sternal contact to the superior end, which has on the internal face a wide, shallow groove at the contact with the acromion process of the scapula.

Measurements.

Approximate length of the vertebral column including skull	37	cm.
Length of cervical region	20	mm.
Greatest antero-posterior diameter of atlas	6	"
Greatest transverse diameter of atlas	23	"
Greatest diameter of cotyli for occipital condyle	15	"
Greatest height of atlas	13	"
Antero-posterior diameter of centrum including odontoid process of axis	8	"
Antero-posterior diameter of centrum of axis at the base of the odontoid process	5	"
Greatest transverse diameter of axis anteriorly	12	"
Greatest height of axis including spine	16	"
Greatest height of neural spine of axis	6	"
Antero-posterior diameter of third cervical	3	"
" " " fourth "	3	"
" " " fifth "	3.5	"

Antero-posterior diameter of sixth cervical	3	mm.
" " " seventh "	3	"
Length of dorsal region	72	"
Antero-posterior diameter of first dorsal	4	"
Transverse diameter of centrum of first dorsal, posteriorly	6.5	"
Height of centrum of first dorsal	3	"
Height including neural spine of first dorsal [1]	13	"
Antero-posterior diameter of centrum of fifth dorsal	5	"
Transverse " " " "	7	"
Vertical " " " "	3.5	"
Total height including spine on fifth dorsal	19	"
Total height of neural spine on fifth dorsal	12	"
Antero-posterior diameter of sixth dorsal	6	"
Transverse " " "	6 5	"
Height of centrum of sixth dorsal	4.5	"
Total height including spine on sixth dorsal	16 5	"
Antero-posterior diameter of centrum of twelfth dorsal	6	"
Transverse " " " "	7.5	"
Vertical diameter of centrum of twelfth dorsal	5	"
Total height including spine on twelfth dorsal	15	"
Length of lumbar region	48	"
Antero-posterior diameter of centrum of first lumbar	7	"
Transverse " " " "	7.5	"
Vertical " " " "	5	"
Total height including spine of first lumbar	15	"
Antero-posterior diameter of centrum of third lumbar	8.5	"
Transverse diameter on posterior face of centrum of third lumbar	9	"
Vertical diameter of centrum of third lumbar	6.5	"
Total height including spine of third lumbar	16.5	"
Antero-posterior diameter of centrum of sixth lumbar	9	"
Transverse diameter of centrum of sixth lumbar, posteriorly	9	"
Vertical diameter of centrum of sixth lumbar	6	"
Total height of sixth lumbar including spine	14	"
Length of sacrum	36	"
Greatest width of sacrum, anteriorly	17	"
" " " posteriorly	11	"
Antero-posterior diameter of first sacral	8.5	"
" " second "	8.5	"
" " third "	7.5	"
" " fourth "	7	"
" " fifth "	5.5	"
Height of sacrum anteriorly, including neural spine	16	"
" " posteriorly, " " "	19.5	"
Total length of eleven anterior caudals	73	"
Antero-posterior diameter of first caudal	6	"
Transverse " " "	4.5	"
Vertical " " "	4.5	"
Total height of first caudal, including spine	9	"

[1] The top end of the spine is broken off in the type.

Antero-posterior diameter of centrum of fourth caudal	6.5 mm.
Transverse diameter of centrum of fourth caudal	4.5 "
Vertical " " " "	4.5 "
Total height of fourth caudal, including tubercle	6 "
Antero-posterior diameter of centrum of eighth caudal	6.5 "
Transverse " " " "	4 "
Vertical " " " "	4 "
Antero-posterior " " eleventh "	5.5 "
Transverse " " " "	3 "
Vertical " " " "	3 "

The Fore-Limb. Pl. XVIII.

The left scapula in *Steneofiber fossor* is fairly complete in the type. In the cotype the scapula is complete, and this one is figured together with that of the type (see Pl. XVIII., fig. 2). This bone is conspicuous on account of the heavy and high spine. The lower border of the latter arises abruptly on the external face of the scapula 5 mm. above the glenoid cavity, then descends again in a curved line to form the very broad acromion process. This process extends much below the glenoid cavity. The spine forms a sinuous curve, and continues to the extreme superior border. It divides the narrow blade so as to form a slightly greater prescapular than postscapular fossa. The glenoid border forms almost a straight line from the glenoid cavity to the suprascapular border. There is no constricted neck above the glenoid cavity on the glenoid border. On a direct side view the spine is seen to greatly overhang the postscapular fossa. The latter is concave the entire length of the bone. The coracoid border of the scapula takes its origin at the base of the metacromion process, and continues in a curved line to within one fourth of the distance to the suprascapular border, where the blade is broadest; then it gently curves to the superior end. The superior half of the coracoid border is turned out so that it forms a concavity on the blade of the prescapular fossa. The suprascapular border is comparatively heavy. There is a heavy metacromion process, which is curved inward and backward. The glenoid cavity has an oblong antero-posterior articulation for the humerus, and is somewhat similar to that of *Aplodontia* and *Cynomys*. There is a neck on the scapula above the glenoid cavity on the coracoid border similar to that in the beaver. The internal surface of the blade, especially superiorly, forms an open, reentrant, 3-shaped curve, like that seen in the beaver. The internal face of the scapula in *Cynomys* has sharp ridges running parallel with the long axis of the bone. This is also seen, in a less degree, in *Aplodontia*. These ridges are not sharp, and are gently curved in *Steneofiber fossor*, and are here more nearly like those in *Castor*. In fact, the bone as a whole, with the exception of the well developed metacromion, and the broad acromion process, is very similar to that of *Castor canadensis*.

The Humerus. — Both humeri are represented in the type as well as in the cotype. This bone (Pl. XVIII., fig. 3) is comparatively short and stout, and has a great lateral expansion distally. Proximally, the large head is well rounded, the antero-posterior diameter being the greatest. The tuberosities are fully as large as those of *Aplodontia*. The shaft is triangular in cross-section, especially so superiorly. The deltoid ridge is strong, with a transversely placed broad plate. This plate nearly equally overhangs the ulnar and radial sides of the deltoid ridge; it is entirely different from that in *Cynomys*, *Aplodontia*, or *Castor*; in the latter it has a large tuberosity on this ridge for the attachment of the deltoid muscle. In the type of *S. fossor* on the ulnar side below the tuberosity there is a short, sharp ridge, turned slightly posteriorly. As has been stated, the humerus is greatly expanded distally, the large internal epicondyle and the greatly expanded supinator ridge being the chief factors in this expansion. As in *Steneofiber montanus*, the supinator ridge extends high upon the posterior aspect of the shaft. The trochlea is relatively as broad and as shallow as that in the beaver. *Cynomys* has the trochlea much deeper, and *Aplodontia* has it about the same depth as *S. fossor*. The supratrochlear fossa is as deep or deeper than in *Aplodontia*, and the anconeal fossa is approximately the same as in that genus. The internal epicondyle is comparatively heavier than in the beaver, and is perforated by a large foramen, as in *S. montanus* and in *Aplodontia*. In the mole the internal epicondyle is relatively heavier than in *S. fossor*, and is perforated by a foramen.

Radius and Ulna. — The right and left radius and ulna are present in the type (Pl. XVIII., fig. 4, 4*a*). The forearm is relatively shorter than in *Cynomys* or *Aplodontia*. The shaft of the radius is a round and irregularly curved rod, and may be in somewhat closer proximity to the shaft of the ulna than is represented in our illustration. Superiorly the radius flares out abruptly into a large head to furnish a good support for the trochlea of the humerus. Distally the radius is even larger than proximally, and sends down a heavy internal and a smaller external process below the large articular facet for the carpals. In *S. fossor* this external process is much better developed than in *Cynomys*, *Aplodontia*, and the beaver.

The ulna has a heavier shaft than the radius; it is compressed laterally, and is broad antero-posteriorly, with a shallow groove extending from the sigmoid notch to near the distal end of the bone on the external side. This groove is better defined than in *Aplodontia*, which genus has the bones of the forearm in close contact throughout. In *Cynomys* the radius and ulna are separated, as in *S. fossor*. In the fossil the sigmoid noteh is wide internally, with a strong supporting rib-like braee, which unites with the shaft below, and is relatively heavier than that seen in *Aplodontia*. The oleeranon process is more produeed upward, and has a stronger museular attaehment in *S. fossor* than in either *Cynomys* or *Aplodontia*. In the type the shaft of the ulna is mueh less eurved than that of the radius, and terminates in a round knob, whieh articulates with the carpals.

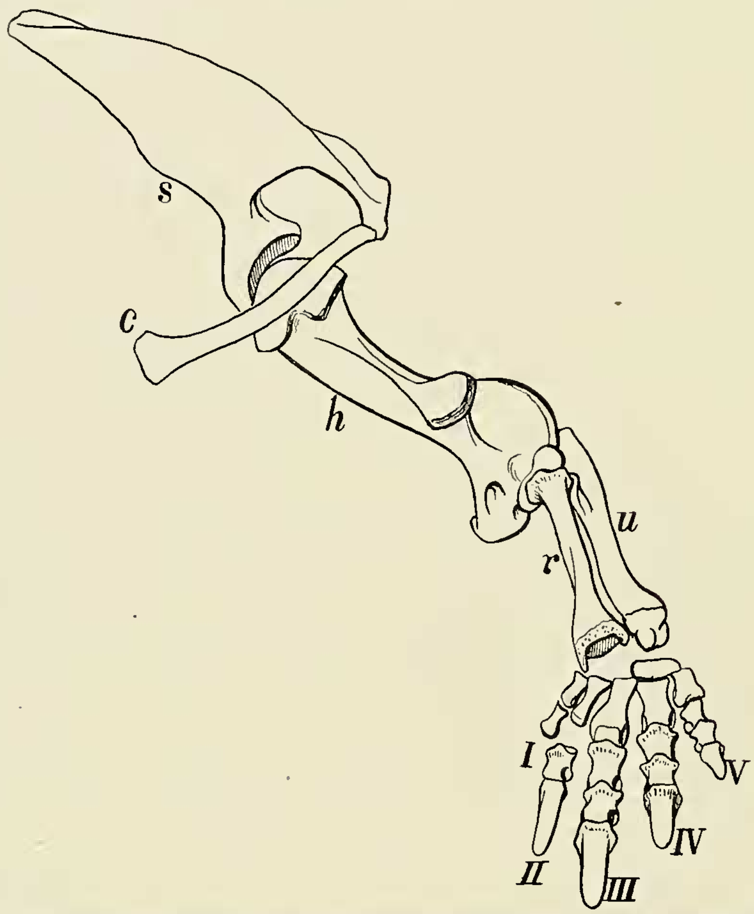


FIG. 3. Fore-limb of *Steneofiber fossor* in position ; somewhat larger than natural size.

The aeeompanying figure (Fig. 3) represents the fore-limb and foot of *S. fossor* in position. The limb presents a striking similarity to that of other fossorial rodents, and approaehes that of the mole in its position. The elongated and narrow scapula of the mole, the heavy elaviele, the strongly built humerus, and the broad foot with the long and powerful unguals, is rather suggestive of the habits of this animal, whieh was probably fossorial to a eonsiderable degree.

The Fore-foot. — Of the earpals there are, unfortunately, only the euneiform, uneiform, and trapezoid, the first and seeond metaearpals, and the first phalanx of the pollex represented in the type. Another individual of the same species, which is more robust (No. 1204) has the phalanges, first, second and third metacarpals, and the unciform preserved. A composite figure of the two specimens, the type, No. 1217 and No. 1204, represents the left manus of *S. fossor* on Pl. XVIII., fig. 5. The slight disparity of the two individuals is at once noticed in this illustration.

The Unciform in the type supports the fourth and fifth metacarpals. This bone is rather broad laterally, and the articulation for the scapholunar and cuneiform, is postero-radially a higher ridge than in *Aplodontia*, and is more nearly like that of *Cynomys*. Distally the articulation for the metacarpals is triangular in outline; it is concave fore and aft, and slightly convex transversely. The bone as a whole is similar to that in *Cynomys*.

The Trapezoid. — The trapezoid is a small irregular bone, which supports mc. II. The inferior articulation is obliquely concave antero-posteriorly. The superior surface is nearly flat.

Metacarpal I. — The first metacarpal is fairly well developed, and is parallel with the long axis of the manus. The first phalanx is strong, and supports an ungual, which is perhaps moderately developed as in *Cynomys*, *Aplodontia*, and other genera of this family. There is what appears to be a radial sesamoid in position in a smaller species. This species will be described later on in this paper.

Metacarpal II. is shorter than in *Aplodontia*, and is of about the same size.

Metacarpals III., IV., and V. are present in the specimen No. 1204, and are relatively short and heavy. Mc. III. is broken off superiorly, but it indicates a bone as long as the corresponding one in *Aplodontia*, and is much heavier. In the fossil, mc. III. is in comparison somewhat more expanded distally than that of *Aplodontia*. Mc. IV. is of the same length as that of *Aplodontia*, but is much heavier than in this genus or in *Cynomys*. In our fossil, the proximal articulation is deep antero-posteriorly. This is due to the large tuberosity on the plantar face of the bone. The shaft is slightly constricted, and the distal end has a strong keel on the palmar face.

Metacarpal V. is extremely short, has practically no shaft, and is as heavy as mc. IV. The articulations for the unciform and the proximal phalanx are quite large on the nodular-shaped bone. There is a deep transverse groove on the plantar face. The proximal row of phalanges are depressed and transversely broad. The proximal articulation is a rounded pit with a moderately deep notch on the inferior margin. The second row of phalanges are even more depressed than the proximal row. Proximally, the phalanges are concave antero-posteriorly and slightly convex transversely. The distal trochlea is broad, flat, and extends to a slight degree on the anterior face of the bone.

The ungual phalanges are heavy, long, and broad, with apparently no grooves anteriorly. The unguals have more similarity to those of the beaver than to those of *Cynomys* or of *Aplodontia*. Proximally, the unguals have a heavy plantar tuberosity. Distally the phalanges terminate in a sharp, depressed point. The plantar surface is broad and flat, and is entirely different from that of *Cynomys* and *Aplodontia;* it is more nearly similar to that of *Geomys*.

Measurements.

Greatest length of scapula including metacromion process	45	mm.
Greatest width of scapula	16	"
Greatest height of spine of scapula	13	"
Length of acromion process	12	"
Antero-posterior diameter of glenoid cavity	9	"
Transverse diameter of glenoid cavity	5	"
Greatest length of humerus	41	"
Antero-posterior diameter of head of humerus	9	"
Transverse diameter of head of humerus	6.5	"
Greatest transverse diameter of distal end of humerus	16	"
Greatest length of radius	32.5	"
Transverse diameter of head of radius	5 5	"
Transverse diameter of distal end of radius	7	"
Greatest length of ulna	46	"
Height of olecranon process	10	"
Approximate length of manus	43	"
Height of unciform	* 3	"
Transverse diameter of unciform	* 5.5	"
Total length of metacarpal I	5	"
Total length of metacarpal II	8.5	"
Total length of metacarpal IV	* 9.5	"
Total length of metacarpal V	* 5	"
Length of ungual of fifth digit	* 6.5	"
Length of ungual of third digit	*13	"
Length of ungual of second digit	*10	"

* These measurements are taken from specimen No. 1204, which is a larger individual than the type.

The Hind Limb. Pl. XVIII.

The Pelvis. — The pelvis is well preserved in the type, and presents considerable similarity to that of *Castor canadensis*. The straight fore and aft diameter of the ilium and ischium, the heavy ischial tuberosity, and the wide posterior border of the thyroid foramen are especially similar in the two genera.

In *Steneofiber fossor*, the ilium is trihedral throughout its entire length. The supra-iliac border is not much expanded. The sacral surface is moderately long, and extends farther anteriorly than in *Cynomys* and *Aplodontia*. The external surface is a concave fossa nearly the entire length of the bone. The ischial border extends well back. The acetabular border is much more prominent than in *Cynomys* or *Aplodontia.* The pubic border is also quite prominent. The acetabulum is deeper than in the recent genera referred to; the ischium and pubis are stronger, and the thyroid foramen is smaller. The pubic symphysis is short, like that of *Aplodontia*, and a detached epiphysis was found in position in the type, similar to that of *Castor canadensis.* The vertical depth from the tuberosity on the ischium to the pubic symphysis is greater than in *Aplodontia* and *Cynomys.* The latter genera have the superior (anterior) part of the ilium turned outward (especially *Cynomys*) at a considerable angle, while *S. fossor* has not this feature. This is due to the greater anterior extension of the ilium, beyond the sacrum, and in order to give space for the posterior lumbar region in the recent genera; while in *S. fossor* the attachment for the sacrum extends more anteriorly, the last lumbar being opposite the supra-iliac border.

The Femur. — Both femora are well preserved in the type. This bone is somewhat more lightly constructed, and the neck below the head is longer than in *S. peninsulatus.* Otherwise the similarity is very apparent in the two species. In *S. fossor* the head is well rounded. The greater and third trochanters are relatively lighter, the whole bone longer, and not so flat as in the beaver. From Professor Scott's description ("The Mammalia of the Deep River Beds," p. 77) it appears that *S. montanus* has the third trochanter "placed more proximally than in *S. peninsulatus.*" In *S. fossor* the third trochanter is placed immediately above the middle of the shaft, as in *S. peninsulatus.* In *S. fossor* the fossa between the condyles is narrower and deeper than in *S. peninsulatus.* The condyles have the same relative proportion, and the trochlea are somewhat deeper than in the John Day species. In *Aplodontia*, the third trochanter is little developed, and is placed high up on the shaft like that in *Cynomys.* In *Castor*, the third trochanter is placed nearly midway between the proximal and the distal ends of the femur.

Patella. — The patella is present in the type, and its characters are nearly like those in *Cynomys* and *Aplodontia*, but different from those in *Castor.* In the latter genus, this bone is thick superiorly, and tapers to a trihedral point inferiorly, while in *S. fossor* it has a more ovate outline, and is as heavy below as above. The bone is larger than in *Cynomys* and *Aplodontia.*

The Tibia. — The tibia and fibula are well represented in the type, being present on both sides. The tibia is 4 mm. shorter than the femur. In the beaver, it is over 20 mm. longer than the femur. In *Fiber zibethicus* the tibia and fibula are also much longer than the femur. In the fossil, the relative length of the femur and the shin-bone is more nearly similar to that of *Cynomys* and *Aplodontia.* Proximally the articular surface has apparently a greater antero-posterior convexity, indicating perhaps a greater flexion of the limb than in *Cynomys* or *Aplodontia*. In the type the median eminence, or spine, is well developed, showing strong attachment for an intra-articular ligament. On the fibular side, near the edge of the articulation, there is a small sesamoid in position, similar to that seen in *Aplodontia* on the articular surface of the tibia. Proximally the shaft is strongly trihedral. The cnemial crest is as strong as in *Aplodontia* and *S. peninsulatus*. In the latter species, the tibia and the femur are of more nearly equal length than in *S. fossor*.[1]

Distally the shaft is more rounded in cross section. The astragalar facets have a somewhat greater antero-posterior diameter than in *Cynomys*, and the posterior downward process or malleolus is strong and not grooved as in the recent genus. The external articular facet for the astragalus is higher up on the bone, has an oblique position, and is much larger than the internal facet. There is a more distinct ridge separating these two facets in *S. fossor* than in *Cynomys*.

The Fibula. — The fibula is relatively as large as that of *Aplodontia* and *Cynomys*, and, as in these genera and the beaver, it is free. The proximal end is somewhat injured in the type, but it indicates a large tuberosity on the external side for the attachment of the lateral ligament, such as is found in *Aplodontia* and *Cynomys*. In *Castor*, this tuberosity is produced into a prominent process, directed downward and outward. In *Fiber zibethicus* this process is also quite prominent. The shaft of the fibula, in the type, is more flattened superiorly than in *Aplodontia*, and is more nearly like that in *Cynomys*. The distal epiphysis is slipped off so that its character cannot be ascertained. The calcaneum indicates, however, that the fibula may have touched the exterior face of the sustentacular facet.

The Tarsus. — The tarsus is represented in the type by the calcaneum, astragalus, cuboid, all the metatarsals, and the phalanges of the third and fourth digits. The second phalanx of the second digit is also present.

The tarsus and carpus of *S. fossor* have approximately the same relative size as in *Aplodontia* and *Cynomys*, and are entirely unlike those in *Castor*, as the following description will show.

Calcaneum. — The calcaneum in *S. fossor* has, as in *S. montanus*, "a short depressed, irregular, and club-shaped tuber." The tuber is relatively much broader than in the beaver, but the oblique exterior face seen in the latter genus, when the bone is in its position in the pes, is also very apparent in *S. fossor*. The articulation for the cuboid is a rounded, shallow pit. The sustentacular facet is relatively as

[1] Professor Cope's illustration ("Tertiary Vertebrata," Pl. 63, fig. 21) is incorrect. This illustration indicates a part of the shaft missing, but the true contact between the two parts has been found, and the bone fitted together, in the American Museum of Natural History.

broad as that in the beaver. As a whole, the calcaneum is perhaps more similar to that of *Castor* than to that of *Cynomys* or *Aplodontia*.

Astragalus. — The principal difference, in the astragalus of *S. fossor* and *Castor*, is found in the prominent tuberosity below the articulation for the tibia, on the internal side near the sustentacular facet in the latter. This tuberosity is not present in *S. fossor*. *Cynomys* has it slightly indicated. In *Aplodontia* it is like that of *S. fossor*. In the latter, the constriction above the navicular facet, is relatively longer than in *Castor*, and is similar to that in *Cynomys*. The articulation for the tibia is regularly convex antero-posteriorly, and concave transversely, forming a rather shallow trochlea, similar to that in *Cynomys*. The navicular articulation is less spherical in the latter genus than in *S. fossor*.

The Cuboid. — The cuboid is injured antero-superiorly, so that the articular surface for the calcaneum is nearly lost, in the type. Judging, however, from the rounded, shallow pit on the distal end of the calcaneum, the facet on the cuboid would have a correspondingly convex, rounded appearance. In the beaver, the calcaneal articulation is a long, narrow, convex surface, which is placed obliquely antero-externally and postero-internally on the proximal face of the bone. The cuboid in the type has a more depressed appearance than in *Cynomys*, the distal end being more expanded, with a larger articulation for mt. IV., and no constriction above this facet on the posterior face of the bone, as in *Cynomys*. There is a strong contact for the ectocuneiform and the navicular.

Metatarsal I. — (Pl. XVIII., fig. 14.) The first metatarsal is somewhat more reduced in length than that of *Cynomys* and *Aplodontia*, and is not at all like the greatly developed hallux of the beaver. The digit is parallel with the long axis of the pes, as in *Cynomys* and *Aplodontia*. The proximal articulation is long and irregular antero-posteriorly, and narrow transversely. The ascending postero-external process, which reaches over and articulates with the plantar face of mt. II. in *Cynomys*, is represented only by a short rounded knob in *S. fossor*; it extends directly backward. The articulation for mt. II. is quite strong. The distal end is slightly enlarged, and the shaft consequently constricted; the transverse diameter is a little greater than the antero-posterior.

Metatarsals II. and III., in the type, are of nearly equal length. Mt. II. has a narrow proximal articulation, and not an expanded head like that in *Cynomys*. The shaft is flat and depressed, distally enlarged, and has a heavy rounded plantar keel. The second digit in the beaver is comparatively lighter than in *S. fossor*; in *Cynomys* and *Aplodontia*, this condition is more nearly similar to that in the fossil. Mt. III. is the strongest metatarsal in the type; there is, however, not much difference in the metatarsals II., III., and IV., as is also the case in *Aplodontia* and *Cynomys*. The proximal articulation in mt. III. is slightly oblique, and extends to the posterior end of the plantar tuberosity. The shaft is broad, slightly constricted, depressed, and the distal articulation is moderately reflected on the anterior face of the bone. There is a strong keel.

Metatarsal IV. is slightly lighter than mt. III., in the type. In the beaver, this digit is a little the heaviest of the series. In the fossil the proximal end has somewhat similar interlocking characters with mt. III. and the cuboid, as in *Cynomys* and *Aplodontia*. These latter genera, especially *Cynomys*, have more rounded and much longer metatarsals than *S. fossor*. In *Aplodontia*, the metatarsals II., III. and IV. are approximately of the same length as those of *S. fossor*, but they are much lighter.

Metatarsal V. (Pl. XVIII., fig. 14) is only half as long as mt. IV. in the type. Its relative length is much less than in *Cynomys* or *Aplodontia*. In the beaver the fifth digit is relatively longer than in *Cynomys*. Metatarsal V. articulates with the outer side of mt. IV., and has no direct articulation for the cuboid. In *Cynomys* the superior end of mt. V. continues above the fourth metatarsal articulation in an upward and outward direction, terminating in a strong tuberosity. This tuberosity is developed in a much less degree in *Steneofiber fossor*, and is more like that of the beaver. The shaft of the bone in the fossil is short, constricted, and trihedral. The distal end is an enlarged, rounded knob, with distinct articulation for the first phalanx.

Phalanges. — The first and second row of phalanges are broad and depressed, similar to those in the manus. The articulation for the unguals is broad, plane, and well rounded on the anterior face of the bone. The unguals are somewhat smaller than on the fore foot, but of practically the same shape. The plantar rugosity is not so prominent as that of the manus.

Measurements.

Greatest length of pelvis	66	mm.
Greatest width of superior border of ilium	11	"
Length of ilium from acetabulum to supra-iliac border	37	"
Length of ischium from posterior border of acetabulum to ischial tuberosity	23	"
Greatest width of ischium and pubis, posteriorly	26	"
Vertical diameter of ischium and pubis at symphysis, when pelvis is in position	15	"
Greatest length of femur	54	"
Transverse diameter of proximal end of femur	17.5	"
Transverse diameter of distal end of femur	13	"
Greatest length of tibia	51	"
Greatest antero-posterior diameter of tibia at proximal end	12	"

Transverse diameter of tibia at proximal end	12.5	mm.
Antero-posterior diameter of tibia at distal end	7	"
Transverse diamet r of tibia at distal end	7	"
Greatest length of calcaneum	15	"
Length of tuberosity of calcaneum	7.5	"
Vertical diameter of tuberosity of calcanenm	7.5	"
Transverse diameter of tuberosity of calcaneum	4	"
Width of sustentacular facet of calcaneum	7	"
Greatest width of caclanenm at sustentacular facet	9.5	"
Greatest length of astragalus	10	"
Greatest width of astragalus	7	"
Antero-posterior diameter of cuboid	6	"
Transverse diameter of cuboid	4	"
Height of cuboid	4	"
Length of metatarsal I	10	"
Length of metatarsal II	14	"
Length of metatarsal III	15	"
Length of metatarsal IV	14	"
Length of metatarsal V	7	"
Length of ungual phalanx of fourth digit	9	"
Length of nngual phalanx of second digit (approximately)	10	"

Restoration of Steneofiber Fossor. Pl. XIX.

The type-specimen (No. 1217) is used as basis for this restoration. The scapula, however, and four of the anterior ribs in the illustration are drawn from the cotype (No. 1208). The greater portion of the fore-foot is reconstructed from the specimen No. 1204, which has also been referred to in the foregoing pages.

The articulated skeleton presents a number of interesting features. The most noticeable are: The cranium, which is unusually large in comparison with the body; the short neck; the long and narrow scapula; and the powerful limbs and feet. The thoracic cavity is quite large, equaling or perhaps exceeding, that of *Cynomys* or *Aplodontia*. The lumbar region is short and strongly built, as in *Aplodontia*. The pelvic region is even stronger than in either *Cynomys* or *Aplodontia*, and is in some respects more like that of *Castor*. The tail is round, rather heavy, and of moderate length.

The length of the fore limb of *S. fossor*, in comparison with the hind limb, is similar to that in *Cynomys*, *Aplodontia*, and *Castor*. The latter genera have the fore limb (the feet excluded) from 12 to 14 mm. longer than the hind limb; while *S. fossor* has the fore limb 10 mm. longer than the hind limb.

The skeleton of *S. fossor* has many features similar to those of *Cynomys* and *Geomys*, but, on the whole, it is perhaps more like *Aplodontia*. There are many cranial characters, together with the longer and broader ungual phalanges, and the much longer caudal region, which are very different from *Aplodontia*.

The specialization of certain parts of the skeleton of *S. fossor* conclusively proves that its ancestors had long been a divergent branch from the true forerunners of the family *Castoridæ*. At the present time I cannot confidentially point to any living rodent of which *Steneofiber fossor* might be the ancestor. That our fossil shows highly developed fossorial characters, is clearly evident from the study of the skeleton. It is plain that the beaver bears no close relation to it, so far as the structure of the limbs is concerned. The long fore-arm, the short femur, the long tibia, fibula, and pes, and the greatly developed hallux, in the beaver, are not suggested in *S. fossor*.

Steneofiber barbouri[1] spec. nov.

This species is founded upon the greater part of a skeleton, which is worked out in half relief (Fig. 4), and is still imbedded in its original matrix inside of a weathered "rhizome" of a *Dæmonelix*. It was found in the same horizon, and only a few hundred feet from where the type of *S. fossor* was discovered. To judge from Professor Cope's illustration ("Tertiary Vertebrata," Pl. LXIII., fig. 22), *S. barbouri* is of approximately the same size as *S. gradatus*, but differs from this species in having much more expanded zygomatic arches, more quadrate molars, larger tympanic bullæ and occipital condyles, and a much broader occiput.

The smaller size of the skull, and other characters, were at first regarded by the writer as individual variations, or possibly sexual differences only, which did not warrant a separation from *S. fossor*. However, a systematic study of the dentition

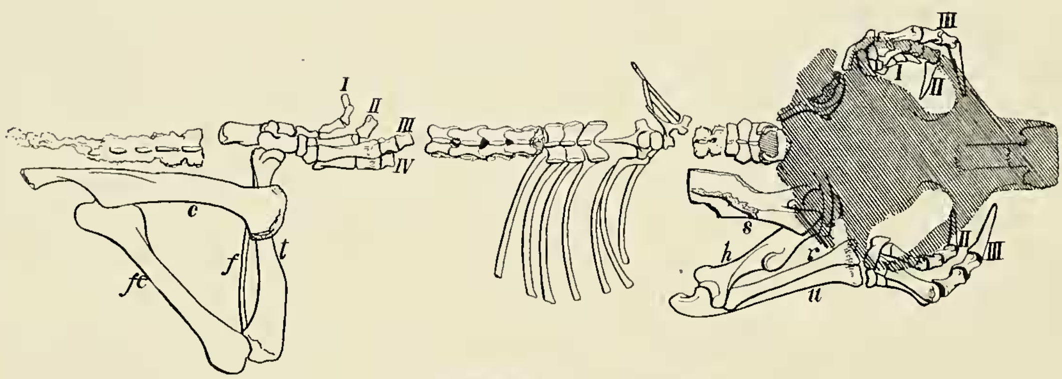


FIG. 4. *Steneofiber barbouri*. ¾ natural size.

and of the cranial characters has been made, which shows such marked differences from the preceding species, that a specific separation was deemed proper. So far as can be judged from the material at hand, the limbs and feet are apparently very little different from those of *S. fossor*, except that they are of smaller size. The

[1] Named in honor of Professor Erwin H. Barbour, in recognition of his highly interesting work on *Dæmonelix*.

dentition and the cranium furnish good specific characters, by which *S. barbouri* may be distinguished from the species first described herein. They are as follows:

Superior Dentition.

The superior incisor is relatively shorter, more curved, and more abruptly sharpened, with the anterior face somewhat more rounded, than in *S. fossor*. This tooth seems to agree more nearly with that indicated in *S. pansus* (*Bull. Am. Mus. Nat. Hist.*, Vol. XX., 1904, p. 250), than with that of *S. fossor*.

The cheek-teeth in *S. barbouri* have a relatively greater antero-posterior diameter in the skull than they have in *S. fossor*, but as in that species they are placed nearly parallel with the long axis of the cranium. The palate is also relatively broader in *S. barbouri*. Very little abrasion has taken place in p^4, so that the grinding surface of the tooth has not attained its greatest diameter. The internal enamel invaginations of all the superior cheek-teeth continue to the alveolar border of the maxilla. This is not the case in *S. fossor*. Molar $\frac{3}{}$ is triangular in section.

The Skull. Pl. XVII., Fig. 9; Pl. XVIII., Fig. 20.

While the general outline of the skull of *S. barbouri* is similar to that of *S. fossor*, a closer study reveals characters, which, besides the smaller size, distinguish it from that of *S. fossor*.

The distance from p^4 to the incisor is relatively a little less in *S. barbouri* than in *S. fossor*. The palatine area of the premaxillaries, in *S. barbouri*, is very little higher than the palate; while this region in *S. fossor* is greatly arched (see Pl. XVII., fig. 1, and Pl. XVIII., fig. 20). The interorbital space in *S. barbouri* is comparatively less constricted, and the temporal ridges are apparently less developed than in *S. fossor*. There may or may not have been a sagittal crest; the parietals are crushed down in the type, so that a positive statement regarding this cannot be made, until the discovery of more material. The anterior part of the zygomatic arch is relatively less robust, and the tympanic bulla larger than in *S. fossor*.

The contour of the skull of *S. barbouri* is not unlike that of the skull figured and described as *S. pansus* (in *Bull. Am. Mus. Nat. Hist.*, Vol. XX., 1904, p. 259). The excavated basioccipitals, (distinctly a character of *Castor*), the shorter palate, and the more vertical and higher ascending ramus of the mandible in the specimen in the American Museum, however, are clearly characters that distinguish it from *S. barbouri*. The latter species has the posterior nares back of m^3; the basioccipital is not excavated, and the ascending ramus of the mandible is at an angle similar to that in *S. fossor*.

The Mandible. — (Pl. XVIII., Figs. 18 and 19.) The inferior incisor has the relatively short appearance seen in the superior tooth. The external enamel folding extends well down on all the cheek-teeth. Premolar $_{\overline{4}}$, as in the upper series, is little worn, and presents two shallow internal, and one deep external enamel fold. The configuration of the crown is naturally more complicated. This would by further wear be changed. The first and second molars have about the same relative size as the tooth in advance of them, which is also the case in *S. fossor*. The last molar is proportionally somewhat smaller than in the latter species. The mandible as a whole is, excepting in size, identical with that of *S. fossor*.

Measurements.

Greatest length of skull	50	mm.
Greatest width of skull	42	"
Width of muzzle	13	"
Width of interorbital constriction	11	"
Distance from incisor to p^4	16	"
Distance from m^3 to occipital condyle	19	"
Width of palate at p^4	4.5	"
Width of palate at m^3	6	"
Antero-posterior diameter of tympanic bulla	11.5	"
Transverse diameter of tympanic bulla, not including constricted tube	10	"
Greatest transverse diameter of tympanic bulla including constricted tube	16	"
Transverse diameter of occipital condyle	13	"
Vertical diameter of occipital condyle	3.5	"

Superior dentition.

Antero-posterior diameter of incisor	3.5	"
Transverse diameter of incisor	3	"
Antero-posterior diameter of p^4	2.5	"
Transverse diameter of p^4	2.5	"
Antero-posterior diameter of m^1	2.5	"
Transverse diameter of m^1	2.5	"
Antero-posterior diameter of m^2	2.5	"
Transverse diameter of m^2	2.5	"
Antero-posterior diameter of m^3	2	"
Transverse diameter of m^3	2.3	"

Mandible.

Greatest length of mandible	37	"
Greatest vertical diameter from coronoid process to inferior angle	21.5	"
Height of coronoid process	5	"
Vertical diameter of jaw in front of $p_{\overline{4}}$, including process on the chin	9.5	"
Vertical diameter of jaw at $p_{\overline{4}}$	10.5	"
Distance from incisor alveolus to $p_{\overline{4}}$	10	"
Distance from $m_{\overline{3}}$ to extreme back of angle	14.5	"

Inferior dentition.

Antero-posterior diameter of incisor	4	mm.
Transverse diameter of incisor	3	"
Antero-posterior diameter of $p_{\overline{4}}$	3.5	"
Transverse diameter of $p_{\overline{4}}$	3	"
Antero-posterior diameter of $m_{\overline{1}}$	3	"
Transverse diameter of $m_{\overline{1}}$	3	"
Antero-posterior diameter of $m_{\overline{2}}$	3	"
Transverse diameter of $m_{\overline{2}}$	2.5	"
Antero-posterior diameter of $m_{\overline{3}}$	2	"
Transverse diameter of $m_{\overline{3}}$	2.5	"

The Vertebræ.

The number of presacrals cannot be ascertained, since the type specimen is considerably damaged, in this region, by erosion. The cervical region is short, as in *S. fossor;* the dorsals are of approximately the same relative size, as well as the ribs and the lumbar vertebræ. The sacrum is almost entirely weathered away, so that its characters cannot be accurately determined. It was apparently long antero-posteriorly and narrow transversely. There remains only a faint indication of four or five proximal caudals, which were short, as in *S. fossor.*

The Clavicle is heavy, and is imbedded with the specimen in almost its natural position. In shape it is similar to that of *S. fossor.*

The Fore-Limb (Fig. 4) — The illustration represents the specimen in position, as it was found. The skull, lower jaws, the posterior portion of the dorsals, and the lumbars have been removed in order to show the characters of the feet. The left fore-foot is in position along the side of the skull. The rest of the limb is lost by weathering, as is also the left hind limb. The right fore-limb is nearly complete. The inferior portion of the scapula is preserved, and presents characters very like those of *S. fossor.* The humerus has also the strong deltoid ridge, that terminates in the transverse broad plate, which is seen in *S. fossor.* The transverse diameter of the distal end is much expanded. There is a large entepicondylar foramen. The radius and the ulna are relatively heavier than in *S. fossor*, but the length of the bone in comparison with the humerus is nearly the same in the two species.

Manus.—The fore feet in the type are practically complete. They are of approximately the same relative size as in *S. fossor.* In the carpus of *S. barbouri*, there are ten bones. The scapho-lunar bone is of the same size as that of *Cynomys.* The articulation for the radius is convex on the anterior part, and concave antero-posteriorly on the posterior part of the bone. In *Cynomys*, the whole proximal articulation is regularly convex antero-posteriorly. On the radial side of the manus in the type (No. 1210), there is a small compressed bone, which I take to be the radial sesamoid. The centrale is of the same size and shape as that in the manus of *Cynomys.*

Metacarpal III. is the longest of all the metacarpals; this is also true in the manus of *Cynomys, Aplodontia,* and other *Sciuromorphs.* The fifth metacarpal in *S. barbouri* is short and heavy, like that of *S. fossor.* The first digit in the type is parallel with the long axis of the foot, and supports a short, but well-formed ungual phalanx.

The ungual phalanges are, as in *S. fossor,* of unusually large size. Their shape is entirely different from that in *Cynomys* or *Aplodontia.* The latter genera have the unguals transversely compressed and high, while *S. barbouri* and *S. fossor* have them depressed and broad, suggesting the mole in this respect. The manus of *Geomys* has also similarities to that of *S. barbouri* and *S. fossor.*

The Hind-Limb. — Part of the pelvis and the left hind limb is preserved in the type of this species. The supra-iliac border of the pelvis is relatively broader, and has a more outward projecting hook in *S. barbouri,* than in *S. fossor.* In the type, the acetabular border of the ilium is sharp, and turns abruptly outward near the suprailiac border, forming the hook referred to above.

The Femur. — The head of the femur is in position in the acetabulum, and is apparently well rounded with a rather short neck. The great trochanter is quite strong, and the lesser trochanter is relatively as large as in *S. fossor.* The bone is injured in the region of the third trochanter. Distally, the femur is also imperfect. There is a weathered fragment of bone in the rotular groove, which is of about the right size to be the patella.

Tibia and Fibula. — The relative size of the tibia and fibula is approximately like that of *S. fossor.* In the type the delicate fibula is in position and is partially imbedded in the matrix. So far as can be judged from the view obtained, the fibula appears to be free as in *Cynomys, Aplodontia,* and the *Sciuromorphæ* in general.

The Pes. — The tuber of the calcaneum in the type is comparatively longer than in *S. fossor.* The pes as a whole has the same relative size to the manus as in *Aplodontia.* Unfortunately the pes is injured in the region of the phalanges. The proximal phalanx of the pollex is present, and its distal articulation indicates that there was a fairly large ungual phalanx. The proximal and median phalanges of the third digit are broad and depressed like those of *S. fossor.*

Measurements.

Total length of the animal, approximately	25	cm.
Length of cervical region, approximately	12	mm.
Length of humerus	30	"

Transverse diameter of humerus, distally	13	mm.
Length of radius	25	"
Length of ulna, approximately	36	"
Length of manus, approximately	35	"
Length of metacarpal I	2.5	"
Length of matacarpal II	6	"
Length of metacarpal III	10	"
Length of metacarpal IV	7	"
Leugth of metacarpal V	4	"
Length of ungual phalanx of first digit	3.5	"
Length of ungual phalanx of second digit	8	"
Length of ungual phalanx of third digit	11	"
Length of ungual phalanx of fourth digit	8	"
Length of ungual phalanx of fifth digit	6	"
Length of ilium from acetabulum to suprailiac border	30	"
Transverse diameter of supra-iliac border	10	"
Length of femur, approximately	41	"
Transverse diameter of femur, proximal end	13	"
Transverse diameter of femur, distal end, approximately	11	"
Length of tibia, approximately	35	"
Length of tuber of calcaneum	6	"
Height of tarsal boues	10	"
Length of metatarsal I	5	"
Length of metatarsal II	9	"
Length of metatarsal III	12	"
Length of metatarsal IV	9	"
Length of metatarsal V., approximately	4.5	"

Probable Habits of Steneofiber Fossor and Steneofiber Barbouri.

Having carefully studied the remains of *Steneofiber fossor* and *barbouri* and compared them with recent fossorial and aquatic rodents, it is confidently believed that the two species under discussion belong to the fossorial kind.

That the remains have been found inside of *Dæmonelix* many times and in different localities, is an interesting fact well worth considering. If, therefore, it is assumed that *Dæmonelix* is the cast of the habitation of these terrestrial and fossorial animals, it becomes easy to explain the great numbers of *Dæmonelices* in certain localities. The extensive areas on the western plains, which are occupied by the highly gregarious genus *Cynomys* are well known. These animals and their underground tunnels offer a splendid example for comparison with what may prove to be the preserved records of the habitations of, at least, two species of the genus *Steneofiber*.

Nine species of *Steneofiber* have now been described from North America. I give here a synopsis of the characters, partially quoted from the original descriptions. In several instances, the types are so fragmentary that the specific characters are very few and unsatisfactory.

PRINCIPAL CHARACTERS OF THE NORTH AMERICAN SPECIES OF STENEOFIBER.

Steneofiber nebrascensis Leidy.

Pr. Ac. Nat. Sci. Philad., VIII., 1856, p. 88.

This species was found in the Bad Lands of White River, S. Dakota, in beds *C* and *D* of Dr. Hayden and Leidy's section. (The Extinct Mammalian Fauna of Dakota and Nebraska.) This horizon is perhaps equivalent to the Protoceras beds.[1] (See Matthew, Classification of the Freshwater Tertiary of the West.—Bull. Am. Mus. Nat. Hist., XII., 1899, pp. 19–75.)

This species is distinguishable by a small tympanic bulla, with the "external auditory passage forming a short oblique canal with its orifice directed outward and backward in the same manner" as in *S. viciacensis*. The angle of the lower jaw "is of less proportionate breadth than in the Beaver and is much bent inwardly. The condyle is higher or at a proportionately longer distance from the base. The single superior convexity" does not extend downward externally as in the Beaver (p. 339, Ext. Mamm. Faun.). Dr. Matthew (Bull. Am. Mus. Nat. Hist., XVI., 1902, p. 301–302) refers certain material in the American Museum collections from the Protoceras beds to Leidy's species, and further characterizes it as follows: "Long and narrow muzzle, small bullæ, sharp sagittal crest, and small braincase. The postorbital constriction is moderate, the pattern of the teeth rather complicated, two deep fossettes anterior to the external inflection on p^{4} remaining in the well worn teeth of No. 1428." (This is the catalogue number of the specimen referred to *S. nebrascensis*.)

Steneofiber peninsulatus Cope.

Bull. U. S. Geol. Surv. Terr., VI., 1881, p. 370–373, and Tertiary Vertebrata, 1884, p. 840.

From the John Day formation (? Diceratherium beds), Oregon.

In the Revision of the *Mylagaulids*, Beavers, and Hares of the American Tertiary (Bull. Am. Mus. Nat. Hist., XVI., 1902, p. 291–310), Matthew defined this species as "more robust than the last [*S. nebrascensis*], distinguishable by the large bullæ and probably by the broader muzzle, wide occiput, larger brain-case and wider sagittal crest. The postorbital constriction is very narrow in the type, but not in the second specimen." (The latter character may indicate individual variation.)

The configuration of the cheek teeth in *Steneofiber* varies so much with age, that

[1] Wortman, *Bull. Am. Mus. Nat. Hist.*, V., 1893, pp. 101–102.

they do not furnish a reliable basis for specific determination. It seems, however, from figures by Cope and Matthew, that the superior grinders retain the enamel invaginations to a comparatively old age. The teeth are larger in comparison with the skull, than they are in *S. fossor*. The posterior narial opening is placed more anteriorly. The tympanic bulla is larger and more oblique, and "the meatal borders are produced into a short tube which is not so long as that of [*Castor*] *fiber*," and the zygomatic arch is less expanded. Cope says that the malar bone is "much expanded in a vertical direction, but has no postorbital angle, resembling in this respect the *S. viciacensis* rather than *C. fiber*." The side view (Tert. Vert., Pl. LXIII., fig. 18) of Cope's illustrations shows a slight postorbital process.

Steneofiber gradatus Cope.

(Paleontological Bulletin, No. 30, 1878, p. 1; Pr. Am. Philos. Soc., 1878, p. 63; Tertiary Vertebrata, pp. 844, 845.)

The type of this species, as that of *S. peninsulatus*, is from the John Day formation (Diceratherium beds?) of Oregon, and is much smaller. "The superior incisors are flat anteriorly, with external angle rounded, and its dentine presents the transverse undulation seen in *S. pansus*. . . . The middle line of the basioccipital bone is keeled, with a fossa on each side. The tympanic meatus is prolonged, and the post-tympanic process is short."

In the revision by Matthew, referred to above, the following characteristics of this species are given. "Short, wide muzzle, postorbital constriction moderate, brain-base short and rounded, temporal crests not uniting to form a single sagittal crest for some distance back of the postorbital constriction. Bullæ of moderate size; grinding series of teeth near together anteriorly, divergent posteriorly. The teeth decrease in size from p^4 to m^3 more than they do in *S. nebrascensis* or *S. peninsulatus;* there is but one fossette anterior to the external enamel inflection on the type, while our referred specimen of *S. nebrascensis* shows two, neither near extinction, although the teeth have attained the same stage of wear."

Steneofiber pansus Cope.

(Proc. Philad. Acad., 1874, p. 222; Ann. Rep. Chief of Engineers, 1875, II., p. 993; U. S. Geogr. Surv. West of 100th Meridian, Vol. IV., 1877, pp. 297–300).

The type of this species consists of fragments of two individuals associated. These were found in the Santa Fé Marls in New Mexico. The horizon is not satisfactorily determined. Dr. Matthews (Bull. Am. Mus., Vol. XX., 1904, p. 258), says: "We suspect from certain allusions in Professor Cope's descriptions that the type of *S. pansus* may also have been derived, along with '*Eumys*' *loxodon*, from similar[1] formation underlying the normal 'Loup Fork' (Upper Miocene) of New Mexico."

Regarding this genus "*Eumys*" *loxodon*, Cope says[2] that Dr. Hayden regards the Santa Fé Marls as late Tertiary, "but without special determination or coördination with other known lacustrine formations of this continent."

The fauna from this formation is, according to Cope, characteristically Loup Fork with the following list of genera: *Hippotherium, Protohippus, Procamelus, Cosoryx, Merychyus*, and known Pliocene species of other genera, among which may be mentioned *Canis, Aceratherium*, etc."

In the paper referred to,[2] Cope described a number of new species from the Santa Fé Marls, among which is (p. 150) *Hesperomys loxodon.* This "was found in the same deposits as the preceding species" which is *Cosoryx teres*, described on the same page (150).

In his later[3] publication, after having discussed *Stenofiber pansus*, Cope provisionally refers *Hesperomys loxodon* to "*Eumys*" *loxodon*, and quotes the original description in full, without regarding the fact that *Steneofiber pansus* and not *Cosoryx teres* is here the preceding species.[4]

In *Steneofiber pansus*, according to Cope, $p^{\underline{4}}$ of both series is conspicuously larger than the rest of the cheek teeth. The second and third molars are similar in proportions in *S. pansus.* From Cope's illustration it appears, that $p^{\underline{4}}$ retains the internal and external enamel inflections for a considerable length of time after the maturity of the animal. "The inferior incisors are almost quadrate in section, the two posterior angles being rounded. The enamel does not extend on either side, and is smooth; its transverse section is slightly convex. . . . The auditory bullæ are very large; they are subsemiglobular and compressed. The humerus preserved lacks epiphyses; its sections are triangular, owing to the presence of aliform angles. One proximal [angle] directed inward and backward is much more prominent than the deltoid crest opposite to it." The deltoid crest, then, is perhaps moderately prominent. The olecranon process of the ulna is short.

In Bull. Americ. Mus., Vol. XX., 1904, pp. 257–260, Dr. Matthew and Mr. Gidley describe a skull as *Steneofiber pansus* which was found in the lower Miocene

[1] "Rosebnd Beds," which, according to Matthew and Gidley, underly the true Loup Fork, and overly the White River on the Rosebud Reservation in South Dakota.

[2] *Proc. Philad. Acad.*, 1874, p. 147.

[3] U. S. Gogr. Surv., W. 100 Mer., IV., p. 300. 1877.

[4] This genus *Eumys* is perhaps not the true Oligocene genus, as it was found apparently in a much later horizon. Cope's description of the specimen is rather brief, and the figures given are unsatisfactory, so that without a study of the type nothing definite can be said regarding its relation to the genus from the Oreodon beds.

of South Dakota. This may or may not be this species. It is distinctly separated from *S. fossor* by the moderately excavated basioccipital without the median ridge, and by the shorter palate, which "is roofed over as far back as the anterior border of the third true molar." In *S. fossor* the posterior narial opening is 4 mm. back of the third true molar.

The ascending ramus of the mandible in the American Museum specimen is more vertical, and relatively higher than either in *S. peninsulatus*, *S. fossor* or *S. barbouri*. The specimen indicates an animal intermediate in size between *S. fossor* and *S. barbouri*.

Steneofiber montanus Scott.

(Trans. Amer. Philos. Soc., Vol. XVII., 1893, pp. 76–78; Bull. Amer. Mus., Vol. XXI., 1902, pp. 303–304.)

Professor Scott writes me that the type of this species is lost. It was found in the Upper John Day beds of Smith River (Deep River), Montana.

"The incisors are narrow, with anterior faces which are less convex than in *Castor* and are covered with a thick layer of orange-colored enamel." "The caudal vertebræ indicate that this species had a longer and more slender tail than the beaver; the anterior portion was provided with chevron bones."

"The humerus has a rather slender, trihedral shaft and prominent deltoid ridge, which terminates in a massive, overhanging hook; this hook is proportionately even better developed than in *Castor*. The supinator ridge is also conspicuous and continues high up upon the posterior aspect of the shaft. . . . The internal epicondyle is very prominent, massive, and rugose, and is perforated by a large foramen."

"The femoral trochanters are well developed, but the third is placed more proximally than in *S. peninsulatus* or in the beaver." In *S. fossor* the third trochanter is like that of *S. peninsulatus*. "The calcaneum has a short, depressed, irregular, and club-shaped tuber; the sustentaculum is notably smaller than in the modern species, and the external projection near the distal end much more prominent; the cuboidal surface is of triangular outline and slightly concave." The third metatarsal is relatively very much more slender and shorter than in *Castor* and of different shape, as the shaft is of nearly uniform size throughout, not being contracted in the middle nor expanded distally; it is also more depressed and flattened, and the head for the first phalanx less enlarged. The proximal end has an oblique surface for the ectocuneiform, which is abruptly constricted behind and continued as a narrow posterior tongue."

The upper and lower teeth of the type are figured in the Bull. Amer. Mus., Vol.

XVI., 1902, p. 303. Matthew states that the type is "allied to *S. nebrascensis*, but larger, with somewhat longer teeth, and enamel inflections deeper and more complex. The type is an old individual, whence the antero-posterior direction of the internal upper and external lower enamel inflections on which Professor Scott largely relies to distinguish the species." The proximal position of the third trochanter on the femur, referred to above, may be considered as of specific value.

STENEOFIBER HESPERUS Douglas.

(Pr. Amer. Philos. Soc., Vol. XX., 1901, pp. 247–248; Bull. Amer. Mus., Vol. XVI., 1902, p. 304).

The type was found on Black Tail Deer Creek, about thirty miles above Dillon, in Beaverhead Co., Montana, in the Oligocene formation; the horizon not clearly determined by characteristic fossils.

The mandible is somewhat smaller than that of *S. pansus* of the Loup Fork of New Mexico. "The animal was not so robust as the New Mexico species." The masseteric area does not extend so far forward. "The anterior surface of the incisors is more convex than in the beaver, *Castor canadensis*, and the antero-posterior diameter is proportionally greater."

"The two anterior [lower] molars (m1 and m2) are broader and longer" than those in *S. pansus*. "The outer enamel inflections do not extend so far down on the outside of the teeth, are more open and incline more forward, and the outer lobes more angulate."

The type of this species is illustrated in Matthew's paper referred to above. In speaking of this specimen Matthew regards it as "close to *S. montanus*, if not identical; the difference in age prevents any accurate comparison. The size is the same at similar points of wear; the upper [should read lower: there are no upper teeth in the type] incisors are more rounded externally, but the value of this character is doubtful." The flat anterior face of the incisors in *S. fossor* is constant throughout the entire series of skulls and lower jaws in the Carnegie Museum collections, and is considered as of specific value.

The inferior premolars are the only basis for comparison in *S. montanus* and *hesperus*. The internal enamel folds are quite distinct on all the cheek teeth and the configuration of the triturating surface of $p_{\overline{4}}$ in *S. hesperus* is certainly more complex than in *S. montanus*. This is due in part to the younger age of *S. hesperus*. I give below the measurements of $p_{\overline{4}}$ taken from the author's descriptions:

Steneofiber montanus.	Length of lower molar ($p_{\overline{4}}$)	0.005 m.
	Width of lower molar ($p_{\overline{4}}$)	0 004 "
Steneofiber hesperus.	Length of $p_{\overline{4}}$ at base	0.005 "
	Width of $p_{\overline{4}}$ at base	0.0045 "

STENEOFIBER COMPLEXUS Douglas.

(Pr. Amer. Philos. Soc., Vol. XX., 1901, p. 249; Bull. Amer. Mus., Vol. XVI., 1902, p. 304.)

The type was found in the Lower Madison Valley, about nine or ten miles south of Three Forks, Montana, in the Oligocene formation; horizon not clearly defined.

The type is before me, and consists of a part of a skull and the lower jaws of a young individual. The temporal ridges apparently extended well backward before they united; the muzzle is small and of considerable length. There is a long and gently curved diastema between the cheek teeth and the incisors; the latter are covered with heavy enamel anteriorly, and have a rounded face. "The masseteric area does not extend so far forward as in *S. hesperus*, and the anterior margin of the coronoid process rises opposite the back part of m_2, and is nearer to the molar. This process has an entirely different form in this species. It is high; the anterior border is straight and rises steeply. The angle is inflected inward and is rounded, not angulate anteriorly and posteriorly, as in *S. viciacensis*."

The anterior face of the lower incisor is not so convex as in *S. hesperus*, the posterior angle is broadly rounded. The outer part of the cutting edge is rounded, not angulate.

The upper cheek teeth are very complex, which is due to the small degree of attrition, the animal being young and retaining the milk premolars. Matthew regards most of the distinguishing characters given by Douglass as subject "to change with age and unsafe specific distinctions. The separate temporal crests may constitute a valid specific distinction." The vertical position of the ascending ramus of the mandible seems to suggest *S. pansus* as described by Matthew and Gidley, and is probably a valid character. When better material is found it may become necessary to unite *S. complexus* with *S. hesperus*.

STENEOFIBER FOSSOR Peterson.

From the Upper Miocene, Harrison (*Dæmonelix*) beds, in Converse Co., Wyoming.

This species has rather small teeth in comparison with the skull; muzzle and nasals moderately long; zygomatic arches greatly expanded; and there is a post-orbital angle on the jugal. Tympanic bulla inflated and flask-like, with a long, constricted tube, and a large external opening. Basioccipital not excavated, but slightly keeled. Palate extending well back of the third true molar. The palatine portion of the premaxillaries is greatly arched above the cheek teeth. Upper and lower incisors very strong with a flat anterior surface.

Cervical region short. A strong sacrum and pelvis; tail moderately long and round. Fore and hind limbs of nearly equal length. Feet broad, ungual phalanges depressed, broad and powerful. The animal robust, and with proportions similar to *Aplodontia* and *Cynomys*.

Steneofiber barbouri Peterson.

From the Upper Miocene, Harrison (*Dæmonelix*) beds, Converse Co., Wyoming.

This species and *S. gradatus* are of very nearly the same size. The muzzle in both species is short and wide; the postorbital constriction moderate, perhaps somewhat less constricted in *S. barbouri*. The brain-case in *S. barbouri* is moderately short. The temporal crests do not unite for some distance back of the postorbital constriction. The type specimen is crushed in this region. The injured parietals, however, show that the weakly developed temporal ridges were separated perhaps even farther back than in *S. gradatus*, and there may not have been a sagittal crest at all in *S. barbouri*. The superior grinding series in this species is more parallel with the long axis of the skull than is the case in *S. gradatus*. The width of the skull across the zygomatic processes of the squamosal is much greater (41 mm.) in *S. barbouri* than in *S. gradatus* (30 mm.). The latter measurement is taken from the illustration in the Tertiary Vertebrata, Pl. LXIII., figs. 22 and 22*a*. The same figures show that the transverse diameter across the skull at p^4 is approximately 27 mm., while that of the Wyoming specimen is only 30 mm., giving the latter skull a greatly different, wedge-shaped, appearance (Pl. XVII., fig. 9). The basi-cranial region back of the molars in *S. barbouri* is shorter, the tympanic bulla and occipital condyles are larger, and the occiput is broader than in *S. gradatus*. The cheek teeth in the latter are decidedly less quadrate in outline, especially m^1 and m^2.

The general contour of the skull of *S. barbouri* is similar to the one described as *S. pansus* by Matthew and Gidley. The latter skull, however, differs in the excavated basioccipital, the shorter palate and the higher and more vertically placed ascending ramus of the mandible.

S. barbouri may be further characterized by the short neck, nearly equally long fore and hind limbs, broad feet, long and strong ungual phalanges as in *S. fossor*. In fact, the general make-up of the skeleton is similar to this latter species. It was, however, a smaller animal.

Euhapsis platyceps gen. & spec. nov.

Type, Plate XVII., Figs. 5, 6, 7, 8.

Generic Characters.

$P\frac{1}{1}\ m\frac{?2}{?2}$. *Teeth hypsodont. Premolar* $_{\overline{4}}$ *has the transverse diameter very nearly as great as the antero-posterior. The teeth in their worn condition have no external enamel inflections. The length of molars* $_{\overline{1}}$ *and* $_{\overline{2}}$ *together is very little greater than that of the preceding tooth* ($p_{\overline{4}}$). *The zygomatic arches are much expanded. The length and breadth of the skull is about equal. The occipital surface slopes forward. Parietals broad and short. No postorbital processes on the frontals. The tympanic bulla is inflated and flask-like. Basioccipitals not excavated, but slightly keeled. Mastoid processes directed outward, instead of downward.*

Specific Characters.

Incisors strong, somewhat trihedral in cross-section, anterior face very little rounded, and with a heavy band of enamel. Muzzle heavy and short. Infraorbital foramen small. Orbit irregular and high. Interorbital region moderately constricted. The space between incisor and $p^{\underline{4}}$ *on premaxillary very little arched. Basi-cranial region back of cheek-teeth short. Otic bulla with long and greatly constricted tube. Occiput low and broad. Two small foramina on either side of the median line of the basioccipital. Skull broad and depressed. Animal somewhat smaller than Aplodontia or Cynomys.*

The type (No. 1220) of this new genus and species consists of the skull and portions of both mandibular rami, and was found in the Upper Monroe Creek beds, near the head of Warbonnet Creek, Sioux Co., Nebraska. This horizon immediately underlies the Harrison (*Dæmonelix*) beds. The specimen was found close to a nearly complete skeleton of *? Mesoreodon*, and in the same sandstone ledge, where the four skeletons of *Promerycochœrus* were found, three of which are now on exhibition in the Carnegie Museum. In the same horizon were also found remains of small carnivores of the family *Canidæ*, small species of camels, and turtles, which are not yet identified.

The general outline of the skull presents similarities to that of *Mylagaulus monodon* (*Mem. Americ. Mus.*, 1901, pp. 377–379), and *Ceratogaulus rhinocerus* (*Bull. Americ. Mus.*, Vol. XVI., 1902, pp. 291–300). The extreme width of the cranium in comparison with its length, the wide and forward sloping occipital surface, and the general depressed appearance of the skull, are especially suggestive of the *Mylagaulidæ*. A detailed comparison, however, shows that the animal was perhaps more nearly related to *Steneofiber*.

The Superior Dentition.

Unfortunately, only the incisors are present in the skull. The grinders have all dropped out. The specimen is injured in the posterior part of the alveolar border and the region of the pterygoids. The superior incisors are nearly as strong relatively, as they are in *Steneofiber fossor*, and are of practically the same pattern: a nearly flat anterior surface, with heavy enamel. The gnawing surface is gradually worn down to a broad, thin, chisel-shaped point.

There are only two alveoli (for p^4, m^1) preserved on the left side of the maxillary; the anterior one (p^4) is smaller than the succeeding one, and does not appear —judging from its size — to have been occupied by a large tooth, such as is found in *Steneofiber*. On the right side, there is no alveole for p^4, and on excavating this side of the maxilla, there was found no evidence of the presence of this tooth. This may be an accidental character of this particular individual, and may have no specific value.

The Inferior Dentition.

The inferior incisors are both broken off close to the roots, and there are three grinders in the left ramus. In cross-section, the incisors are subtriangular, similar to the upper incisors, with a broad, smooth, heavily enameled anterior face.

The premolar (p_4) has very nearly twice the antero-posterior diameter of the succeeding tooth, which is contrary to what appears to have been the case with the corresponding teeth of the upper jaw, judging from the alveolus. The width of p_4 slightly exceeds that of the succeeding two molars. There are three irregularly placed enamel lakes on the grinding surface of p_4; two of them antero-internal and transverse, the third oblique and postero-external. On the postero-internal enamel border there is a minute groove. This groove may be the remnant of the third internal enamel fold, as in *Steneofiber*. There is a slight evidence of the third enamel lake as in the latter genus, but in *E. platyceps* its greatest diameter is antero-posterior and it is not transversely placed.

The diameter of the first molar is one third greater transversely than antero-posteriorly. It has two enamel fossettes; the anterior one is transverse, and appears to be the only remaining evidence of the internal enamel folding, the posterior one is curved and oblique, similar to that on p_4. The second molar is similar to the first in every detail. There is apparently no alveolus for m_3, and it is questionable if there was one. The root of the incisor is very close to the alveolar border in this region, so that, if the third molar had been present at any time, it must have been small, and must have had a weak support. The teeth have roots similar to those in the genus *Steneofiber*.

The Skull.

The general outline of the skull, as has already been stated, is suggestive of the *Mylagaulids*. It has, however, a number of characters similar to those of *Steneofiber fossor*. There are important characters, which probably, when the superior grinders are known, will show still more important generic diversity from *Steneofiber*. The skull — minus the nasals and the cheek-teeth — is excellently preserved, and deserves a somewhat detailed description.

The greatly expanded superior border of the premaxillaries indicates a broad rostrum, which in width exceeds that of the interorbital space, although not to the same degree as that which obtains in *S. fossor*. The nasals are comparatively broader than in *Steneofiber fossor*, but do not extend any farther posteriorly. About midway between the anterior and posterior ends, the nasals are broadest, then they gradually taper to a serrated, rounded point at the junction of the frontals. The fronto-premaxillary suture appears to be on a line with the posterior end of the nasals, as is the case in *Steneofiber*, *Cynomys*, and *Aplodontia*. Thus the nasals in *Euhapsis* are entirely supported laterally by the premaxillaries.

The frontals are rather short and broad anteriorly, with a heavy rounded supra-orbital margin. The interorbital space is relatively as wide as that found in the family *Geomyidæ*. The posterior extension of the frontal is also somewhat similar to that in the latter family, with a slightly more pointed posterior process. There are no postorbital processes on the frontals.

The sutures in the posterior portion of the skull are not discernible, so that the forms of the separate bones of this region cannot be ascertained. The parietal is very wide, and necessarily short, on account of the forward slope of the occipital surface. The median line is indicated by low ridges, which nearly meet to form the low sagittal crest. The superior portion of the parietals have only a slight convexity from side to side, giving a broad and depressed appearance to the skull. The inter-parietal is not visible. The lambdoid crest, which takes its origin at the postero-external point (mastoid process) of the squamosal, is highly characteristic in this form. The extreme anterior slope of the occipital surface places the union of the lambdoid and sagittal crests forward one fourth of the total length of the skull. This forward slope is greater than in *Ceratogaulus rhinocerus* Matth. The latter has a slope of 30° from a vertical position (Bull. Amer. Mus., XVII., 1902, p. 293), while *Euhapsis platyceps* has a forward slope of about 55° from the posterior face of the occipital condyles to the top of the crest. The lambdoid crest is moderately high, but very sharp. The entire area of the occipital surface has a gentle convexity from the base of the condyles upward and outward to the top of the crest, presenting a comparatively plane surface. The transverse diameter of this surface is twice that of the vertical. The mastoid bullæ are only slightly inflated. The supraoccipital cannot be outlined by the suture, but is undoubtedly very large, to judge from the broad aspect of the skull in this region. The basioccipital is not excavated as in the beaver; it is somewhat triangular in shape, with two small perforations, one on each side of the median line opposite the posterior part of the tympanic bullæ. Postero-laterally from these perforations are the rather large condylar foramina. The occipital condyles are of moderate size, not very greatly separated inferiorly by the deep triangular notch; and they are farther separated from the tympanic bulla than in *Steneofiber fossor*. The foramen magnum is of large size and subtriangular in shape. The mastoid process is of medium size, and has a unique outward and horizontal position, similar to that in *Aplodontia*, but is more rounded. The long, constricted tube of the auditory bulla is supported by the mastoid process nearly to its outer portion — the external auditory meatus. The latter opening is broken away in our specimen, but was perhaps not of great size to judge from the greatly constricted tube. The tympanic bulla is much inflated, chiefly laterally and antero-posteriorly; it is depressed vertically, and takes up a considerable area of the basicranial surface. The shape of the bulla is flask-like, with an unusually long and much more constricted neck than in *Aplodontia*. The genus *Entoptychus* from the John Day Miocene has the constricted neck of the bulla; but the general features of the skull in *Euhapsis* are entirely different from it, and bear a more general resemblance to *Steneofiber*.

The Squamosal has a considerable posterior process, which unites with the base of the mastoid process from which the lambdoid crest takes its origin. In front of this process, and immediately behind the zygomatic process of the squamosal is a deep rounded emargination (the postglenoid notch), similar to that in *Steneofiber*, *Entoptychus*, and the recent genus *Aplodontia* and the *Geomyidæ*. In *Euhapsis platyceps* the zygomatic process of the squamosal is of small size and rather short; the jugal and zygomatic process of the maxillary furnishing the greater part of the arch.

There is an obtuse, round, postorbital swelling, from which continues latero-inferiorly a sinuous ridge, which is continuous with the anterior margin of the zygomatic process. The glenoid cavity is not as distinctly formed as in *Fiber zibethicus*, and indicates a considerarable lateral motion of the mandible. The anterior border of the squamosal cannot be accurately determined, since the suture is obliterated at the posterior margin of the orbit. The parieto-squamosal suture is much lower down on the side of the skull than in *Steneofiber fossor*.

In the region of the sphenoid bones the skull is damaged. The basisphenoid appears to be crowded especially posteriorly, where the tympanic bulla is encroaching upon it. The posterior part of the basisphenoid sends a backward projecting process on either side of the median line. These processes are fused with the internal face of the otic bullæ, and extend to a considerable distance back on these bones. The pterygoid fossa is quite large, and the external wing of the pterygoid seems to have reached well back, and is fused with the floor of the brain-case very close to the antero-external face of the tympanic bulla. The foramina, ovale and rotundum, seem to be coalescent, as in *Aplodontia*.

The Jugal is nearly vertical anteriorly, and is a comparatively heavy plate of bone. In shape and size it is very nearly like that of *Castor*, the vertical portion just back of the orbit being comparatively deeper than in the recent genus. At the extreme inferior jugo-maxillary suture, the arch forms a heavy, rounded, tubercle-like angle. At the supero-anterior portion the suture is not distinct, but I would judge that the jugal forms a suture with the lachrymal ; the suture of the latter bone is also indistinct. There is a large lachrymal foramen in the orbit, similar to that of *Castor*.

The greatest width of the skull is obtained across the posterior part of the jugal. The extraordinary width and strength of the zygomatic arch is one of the principal characters of the skull, and recalls such recent forms as the *Geomyidæ* and *Aplodontia*, and also the Loup Fork *Mylagaulids*.

The postorbital process on the jugal is fairly well developed in *Euhapsis platyceps*. The orbit is imperfectly rounded, and is placed high.

The Maxillary. — The zygomatic arch of the maxillary is very similar to that of *Castor*, but arises more posteriorly on the maxillary (opposite $m^{\underline{1}}$), than in the beaver (opposite $p^{\underline{4}}$). The infraorbital foramen is small and almost entirely hidden by a vertical ridge or projection from the maxillary like that in *Castor*. In fact the skull in this region resembles the recent beavers, with the exception of the much more produced angle at the inferior jugo-maxillary union on the zygomatic arch. [1]

The Premaxillaries.—The premaxillaries are broad, short, and heavy. Inferiorly the palatal surface is comparatively broad and has not the long, gentle, and concave antero-posterior sweep between the alveolar border of the maxillaries and the incisors, which is seen in *Steneofiber fossor* and the recent beavers. In this respect *Euhapsis platyceps* is more nearly like *Arctomys monax*, which has a continuous, almost horizontal palatal surface from the posterior nares to the incisors. The posterior limit of the premaxillaries in *Euhapsis* is just back of the long, narrow incisive foramina ; thence the suture ascends in an almost vertical line immediately in front of the preorbital foramina to the superior borders of the zygomatic processes, and across the face in a slight posterior obliquity to meet the posterior process of the nasals. The anterior narial opening appears to have a greater transverse than vertical diameter. The nasals are not present in the type.

The Mandible.

The angle and the posterior part of the mandible are broken off. The fragment shows that the horizontal ramus is rather short, which is in keeping with the short cranium. The symphysis is long and heavy, inferiorly it terminates in a downward projecting process, similar to that in *Steneofiber fossor* and the recent beavers. The alveolar border is nearly parallel with the long axis of the jaw. The base of the coronoid process is present and indicates an exceedingly outward pointing direction of this process, which naturally corresponds to the widely separated glenoid cavities in the skull. The angle, perhaps, had similar characters to that in *Aplodontia*.

Measurements.

Greatest length of skull	60	mm.
Greatest width of skull	58	"
Greatest width of occiput at mastoid processes	47	"
Greatest width of muzzle	14	"
Vertical thickness of skull including occipital condyle to top of sagittal crest	19	"
Vertical thickness of skull including tympanic bulla	22	"
Vertical thickness of muzzle, approximately	12	"
Length of muzzle from zygomatic process to anterior nares	15	"
Distance from incisor to p^4	18	"
Distance from and including p^4, to and including occipital condyle	39	"
Greatest width of occipital condyles	15	"
Greatest vertical thickness of condyles	4	"
Greatest antero-posterior diameter of incisor	4.5	"
Greatest lateral diameter of incisor	5	"

Mandible.

Total antero-posterior diameter of the three grinders	10.5	"
Total antero-posterior diameter of $p_{\overline{4}}$	5	"
Total transverse diameter of $p_{\overline{4}}$	4.5	"
Total antero-posterior diameter of $m_{\overline{1}}$	2.5	"
Total transverse diameter of $m_{\overline{1}}$	3.2	"
Total antero-posterior diameter of $m_{\overline{2}}$	2.5	"
Total transverse diameter of $m_{\overline{2}}$	3.2	"
Depth of jaw at $p_{\overline{4}}$, including process on the chin	16	"
Depth of jaw at base of process on the chin	12.5	"
Depth of jaw at $m_{\overline{2}}$	10	"
Antero-posterior diameter from $p_{\overline{4}}$ to incisor (approximately)	11	"
Greatest length of the jaw-fragment	27	"

SUGGESTIONS REGARDING THE PROBABLE ORIGIN OF DÆMONELIX.

In 1891, Professor Erwin H. Barbour of the University of Nebraska discovered some peculiar fossils, called by him *Dæmonelix*.[1] After extensive study, he arrived at the conclusion that these strange forms were the remains of gigantic plants. Professor Cope[2] and Dr. Theodor Fuchs[3] suggested that the "explanation of these objects seems to be that they are the casts of the burrows of some large rodent." Mr. Joseph T. James,[4] in a paper read before the Biological Society of Washington, is inclined to associate *Dæmonelix* with certain small spiral concretions found in late Tertiary deposits in Switzerland, called "Screw-stones" by Oswald Heer.[5] These and *Dæmonelix*, James regards as belonging to the same order as *Spirophyton* (or *Taonurus*),[6] and *Spiraxis*[7] from the Chemung rocks of New York. He seems to hold the opinion that Heer was wrong in interpreting these screw-stones as casts of

FIG. 5. Field sketch of a weathered rhizome containing the type-specimen of *Steneofiber barbouri*. No. 1210.

spiral tubes made by burrowing shells. The fact, however, that a specimen of a burrowing shell (*Lutraria senna*) was found in one of these spirals, carries more conviction with regard to the origin of them than mere speculation could do.

The party sent by the Carnegie Museum to northwestern Nebraska, into the *Dæmonelix* region, in the summer of 1904, was fortunate in discovering rodent remains inside of these "cork-screws" (see note in *Science*, September 9, 1904, p. 344). Re-

[1] Notice of new gigantic fossils. *Science*, V., 19, pp. 99–100, and "Notes on a New Order of Gigantic Fossils," University Studies, No. 4, July, 1892, pp. 301–335, pl. 6.

[2] The *American Naturalist*, June, 1893, pp. 559–560.

[3] "Ueber die Natur von Dæmonelix Barbour," *Ann. k. k. Naturhist. Hofmus.*, Wien., 1893, pp. 91–94.

[4] *The American Geologist*, Vol. 15, No. 6, June, 1895, pp. 337–342.

[5] "Die Urwelt der Schweiz," 1865, p. 438.

[6] 16th Ann. Rep. Reg. Univ. New York, Albany, 1863, pp. 76–83.

[7] *Ann. N. Y. Ac. Sci.*, 3, 1885, pp. 217–220.

calling Professor Barbour's statement of having found remains of a rodent in a "rhizome" of *Dæmonelix*,[1] the search was vigorously carried on during our stay in this region.

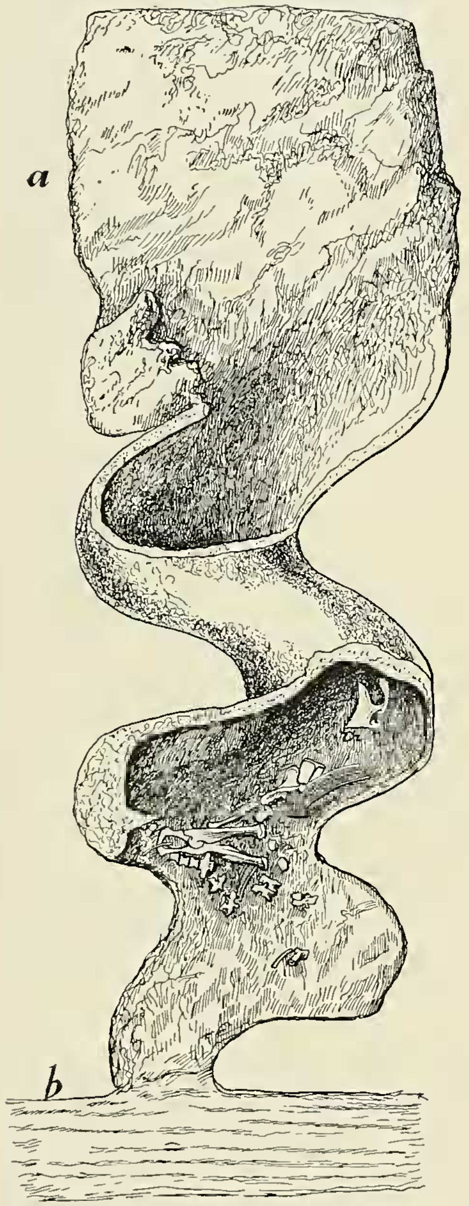


FIG. 6. A weathered portion of a *Dæmonelix* containing a skeleton of *Steneofiber fossor*. Total length of specimen from horizontal stratum *a* to *b*, approximately 61 cm.

In a locality, where *Dæmonelix* is found in great numbers, one is always sure to find rodent (*Steneofiber*) remains. Considerable pains was taken to study these so called plants from all possible points of view, and the conclusions arrived at are at variance with those of the advocates of the plant-theory.

It seems reasonable to believe that *Dæmonelix* is the cast of a rodent-burrow for the following reasons. Remains of rodents, which possess highly developed fossorial characters are found inside of the casts. These rodents are of the proper size in comparison with the average size of *Dæmonelix*. I have seen no very small specimens of the latter exhibiting the wonderful regularity of form met with in the larger ones: such small ones as I have seen cannot properly be classified with the typical *Dæmonelix*.

On the hypothesis that these screws are casts of burrows, it would seem likely that in making them the rodents tamped and firmly packed the walls of their tunnels. The secretions of the animal, and the constant passing back and forth would, I think, greatly help to solidify the walls, since these habitations might have been occupied for a considerable length of time. In support of this it may be said that it is seldom that articulated skeletons are found in *Dæmonelix*, but in the majority of cases the bones are scattered (perhaps by the inhabitants of the burrow), and quite often only the head is found crowded close to the wall, or inside of the rim

[1] In passing through Lincoln, Nebraska, on my way East, I saw Professor Barbour who was kind enough to show me most of the *Dæmonelix* material in the museum. The rodent mentioned by him is about the right size to have made the mold of the specimen in which it was found. It is a *Steneofiber*.

of the compact mass of roots, which are to be spoken of later. In two cases skulls were found near the rounded ends of "rhizomes," and crowded close to the inside surface of the surrounding silicified zone of roots. The type-specimen of *Steneofiber fossor* (described in the preceding pages) was also found near the end of one of those "rhizomes."

The accompanying figure (Fig. 6) is a diagrammatic illustration intended to represent an actual specimen of an apparently incomplete *Dæmonelix* in the Carnegie Museum collections. This specimen was found by the writer, and presents some interesting features. It is a very short spiral, much weathered, and contains part of the skeleton of *Steneofiber fossor*. This short spiral was found, in situ, between two layers of more coherent material than that in which it was imbedded. The thin stratum below the lower end of the spiral (Fig. 6, *b*) is a horizontal layer of organic structure, some three or four inches thick, and intermixed with sand. This organic structure resembles some sheets of vegetable growth covered by a sudden influxes of sand brought in by water, and was simply a portion of the deposit in which the burrow was afterward made. The stratum overlying this specimen (Fig. 6, *a*) is also quite horizontal, but consists of much harder, silicified material, and is more irregular in thickness. Such hard layers of sandstones are quite common in these beds. The upper end of this specimen of *Dæmonelix* gradually loses its character, and cannot be traced upward into this hard cap of sandstone. The latter was probably formed by the deposition of sand in a pool of water on the surface of the ground. The exit of the *Dæmonelix* hole naturally lost its shape under these conditions.

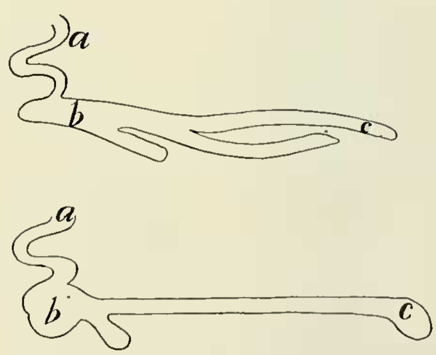
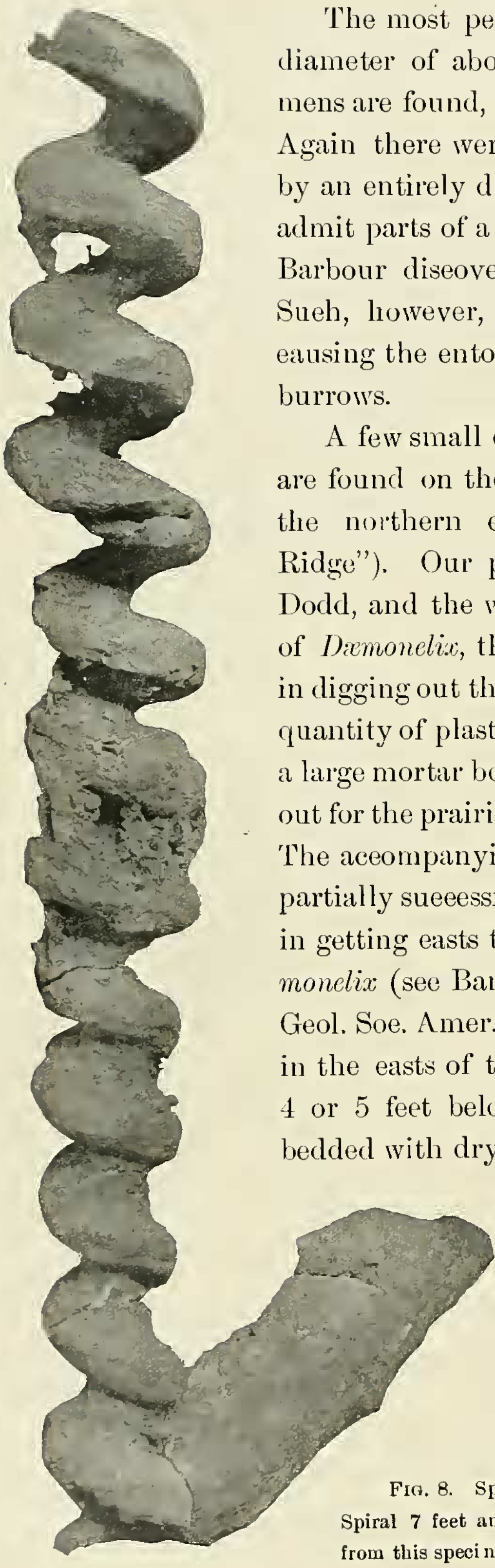


FIG. 7. Forms of *Dæmonelix* sometimes found. Taken from field sketch of exposed specimens lying on the surface with only the base of the vertical spiral attached to the "rhizome." *a* to *b*, 18 inches; *b* to *c*, 14 feet.

The more perfect specimens of *Dæmonelix* possess so-called "rhizomes," which are nearly always larger in circumference than the vertical spiral. Occasionally, this "rootstalk" is branched, two, three, and even more times. Each of the branches is of approximately the same general size, with local enlargements and pockets up to the extreme blunt and rounded end. No instance was found of these "rhizomes" crossing one another, so as to form a short kink, such as is often seen in roots of recent plants. The end of the rhizomes is often found enlarged in a more or less hemispherical manner. I have often traced them for six, and sometimes for fifteen feet from the base of the spiral to their end.



The most perfect specimens of *Dæmonelix* have an average diameter of about 6 to 10 inches. Quite often large specimens are found, that have not the even symmetry of the spiral. Again there were others representing, perhaps, burrows made by an entirely different animal, large enough at the surface to admit parts of a skeleton of a larger mammal, such as Professor Barbour discovered in an irregular fragment of *Dæmonelix*. Such, however, might also be burrows that have caved in causing the entombment of larger objects partially within the burrows.

A few small colonies of Prairie Dogs (*Cynomys ludovicianus*) are found on the table land between the Niobrara River and the northern exposure of the Miocene formation ("Pine Ridge"). Our party (consisting of Messrs. T. F. Olcott, A. A. Dodd, and the writer) had become so interested in the study of *Dæmonelix*, that it was decided to make a few experiments in digging out the burrows of these recent fossorial animals. A quantity of plaster of paris was accordingly purchased, and with a large mortar box, a barrel of water, and a supply of sand we set out for the prairie dog town, to make some casts of these burrows. The accompanying diagrams (Figs. 9 and 10) show that we were partially successful, if not in finding a symmetrical spiral, at least in getting casts that were irregular like some specimens of *Dæmonelix* (see Barbour's illustrations, figs. 17, 18, and 19 in Bull. Geol. Soc. Amer., Vol. 8, 1897, pp. 305–314). There were found, in the casts of these burrows, many fine rootlets at a depth of 4 or 5 feet below the surface. The nest (Fig. 9, *d*) was well bedded with dry grass brought down from the surface. Mixed with this bedding were many beetle-wings, worms, and remains of grasshoppers. Particular attention was paid to the solidity of the burrows. It is remarkable how firm the walls of these tunnels are in this loose and rather incoherent sand, which is a redeposition of the eroded Miocene sediment.

FIG. 8. Spiral and part of "rhizome" of *Dæmonelix*, No. 17 (field number). Spiral 7 feet and 8 in. long. Many microscopic slides (Pl. XXI.) were taken from this specimen.

It seems reasonable, that, after our Miocene rodents vacated their burrows, the roots of plants growing on the surface would find their way down the spirals as well as down the straight shafts. The tamped walls remained harder than the surrounding ground, and when the roots and rootlets reached these walls, they followed the line of contact between the walls and the inside filling, perhaps similar to the roots

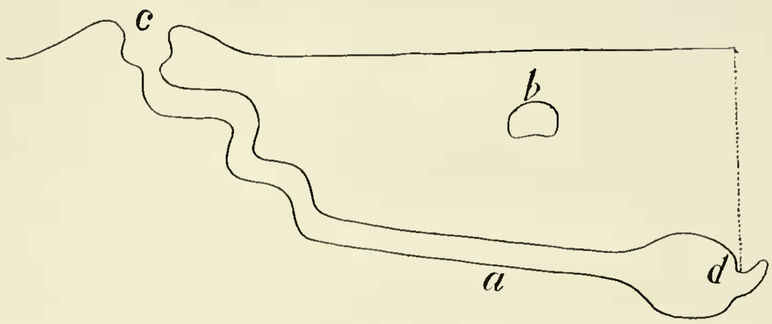


FIG. 9. A newly dug prairie dog burrow. From a field diagram. *c*, Exit of burrow ; *a*, nearly horizontal tunnel about 5 inches in diameter ; *d*, nest 8 inches in diameter and four feet under surface ; *b*, cross-section near nest showing emargination of cast caused by bedding. From *c* to *d*, 9 feet.

of a potted plant. Occasionally a root would pierce the wall, and continue on its way to the next coil. This is seen on nearly all specimens of *Dæmonelix*. As has been stated before, there is a cylinder of tangled roots on the outside surface of *Dæmonelix*. Toward the center of the casts the roots are much less numerous.

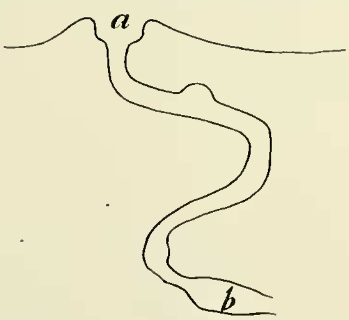


FIG. 10.

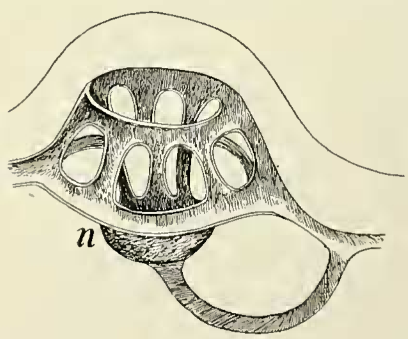


FIG. 11.

FIG. 10. Diagram of cast of an old burrow of Prairie Dog. *a*, exit ; *b*, at this place the burrow was caved in. From *a* to *b*, 10 feet.

FIG. 11. An underground fortress of a mole, *Talpa europæa ;* after J. G. Woods, in "Homes Without Hands." *n*, nest.

In speaking of the recent mole, J. G. Woods (in "Homes Without Hands") says that "we do not generally know the extent or variety of this animal's tunnels or that it works on a regular system, and does not burrow here and there at random." In this volume is an illustration of a mole-hill (Fig. 11), which is represented (by permission of the publisher) in the accompanying figure. If this illustration correctly represents the actual habitation of the animal, it must at once be admitted that *Steneofiber*, which I think is responsible for *Dæmonelix*, has an able competitor in underground engineering in our recent mole.

It cannot be denied that certain features of *Dæmonelix*, for instance the straight vertical axis inside of the spiral, are not easily explained, and that we have not yet arrived at a complete understanding of all the details connected with these structures; but it is very likely that these difficulties will be removed, when we know more of the underground habitations of fossorial animals.

The following notes are observations by Mr. O. E. Jennings, custodian in the Department of Botany, kindly submitted to the writer for publication in connection with this paper.

NOTES ON THE VEGETABLE TISSUES IN DÆMONELIX.

An examination of thirty-two microscopical sections obtained from various parts of the so-called devil's corkscrews (*Dæmonelix*), in the collections of the Carnegie Museum, invariably revealed the fossilized remains of vegetable tissue. Although the sections had been cut from many different places in the *Dæmonelix* specimens, the vegetable tissues were usually more abundant in those sections obtained near the surface of the specimens, and the tissues in these sections gave better results under the microscope. The sections best showing the cellular structure and the differentiation of tissues were longitudinal sections cut parallel to the surface of the so-called corkscrews. A careful study of the slides involved the examination of a large number of tissue fragments, as in some of the slides, at least one fourth of the total area of the section was occupied by plant remains.

The vegetable tissues are apparently simply the remains of a mesh of roots such as is sometimes found clogging a tile drain or sewer. The tissues were most commonly found in the form of hollow tubes, such as would be obtained by sectioning rubber tubing at various angles. The central portion of the root has, in most cases, disappeared leaving only the outer tissues — the epidermis and the cortex. The root cap was searched for in vain, although root-hairs were rather common.

The reason, that the thin epidermal covering and the rather large thin-walled cells of the cortical tissue should be the best preserved, may be, that these parts of a living root soon become more or less impervious to water. That portion of a living root just back of the tip is the most absorptive. In the older portions farther back. the epidermis may have become cutinized, or the cortex may have become suberized, or both; in either event the tissue thus becomes impervious to both water and gases.

On the other hand, the tissues of the central portion of the root, the stele, even though they may have become lignified or woody, are still permeable to these fluids, and thus can be readily entered by some of the bacteria of decomposition.

A few sections were found showing more or less completely the entire structure of the root, but the detail of the vascular bundle could be made out only with considerable difficulty, as the cells were usually very dark and the structure mostly obliterated. Enough was evident, however, to plainly indicate that nearly all of the roots were those of angiosperms, the cells discerned being quite typical. Rather large tracheæ, with the customary rings and reticulations, together with longer cells of a smaller diameter, some of the latter also showing reticulations, were quite plainly to be seen in the stele. No pith cells were evident but the woody elements were enclosed by a well developed bundle sheath. Fragments of older roots with a strongly developed cortical region were found; in some of these the rectangular cortical cells were built up with all the regularity of brickwork, each successive layer being regularly and perpendicularly superimposed.

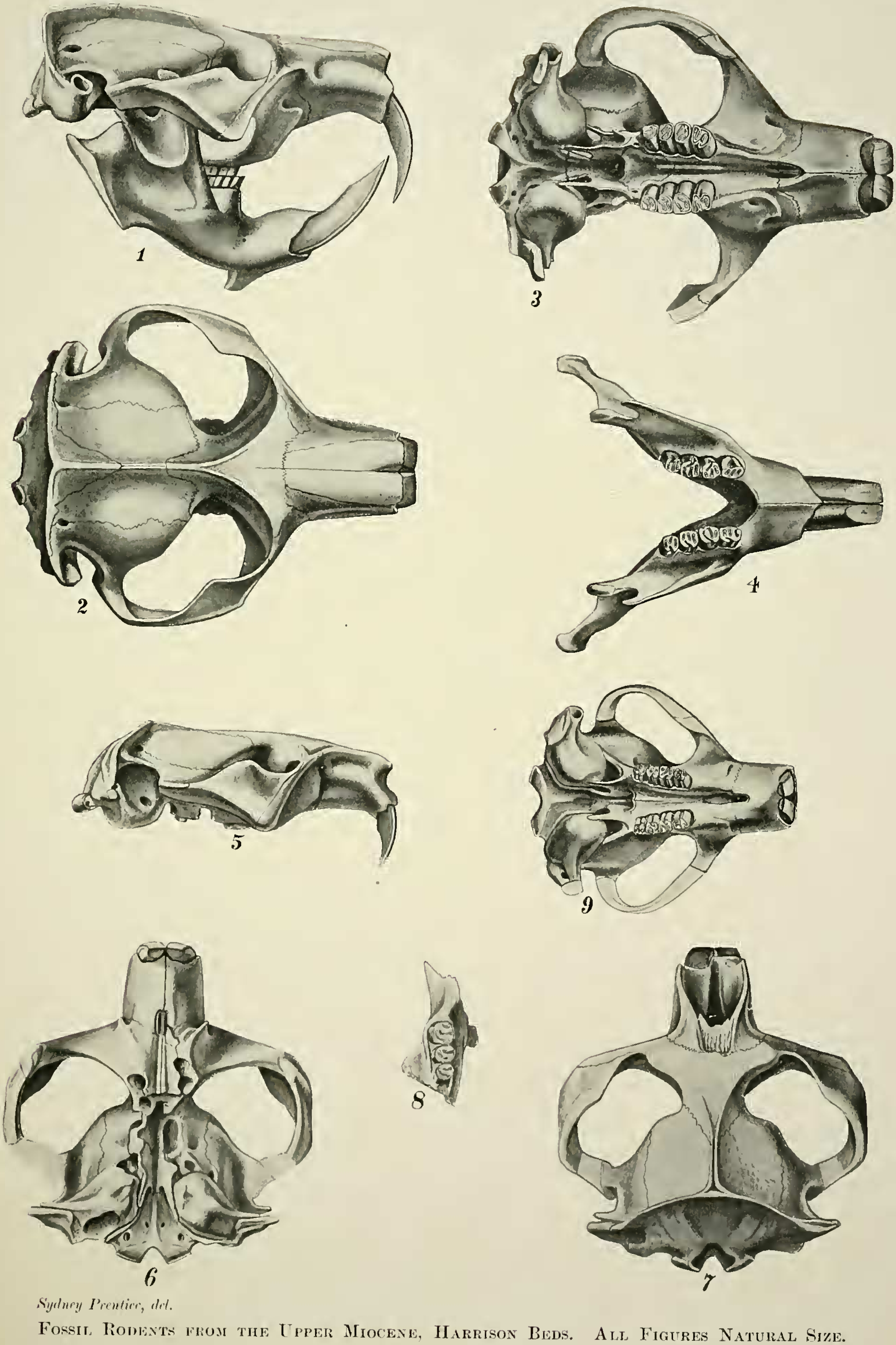
One of the main structural differences between stems and roots lies in the manner in which branches originate. In stems the branches originate near the surface but in roots the branches originate on the vascular cylinder and burrow upward through the cortex thus disturbing the arrangement of the cortical cells. An example of this was found in one of the sections, as may be seen by consulting the figure.

CARNEGIE MUSEUM, January 24, 1905.

EXPLANATION OF PLATE XVII.

FIG. 1. *Steneofiber fossor*, type No. 1217. Side view of skull and lower jaws.
FIG. 2. *Steneofiber fossor*, type No. 1217. Top view of skull.
FIG. 3. *Steneofiber fossor*, cotype, No. 1208. Palate view of skull.
FIG. 4. *Steneofiber fossor*, cotype, No. 1208. Crown view of inferior dentition.
FIG. 5. *Euhapsis platyceps*, type No. 1220. Side view of skull.
FIG. 6. *Euhapsis platyceps*. Palate view of skull.
FIG. 7. *Euhapsis platyceps*. Top view of skull.
FIG. 8. *Euhapsis platyceps*. Crown view of inferior dentition.
FIG. 9. *Steneofiber barbouri*, type No. 1210. Palate view of skull.

All figures natural size.



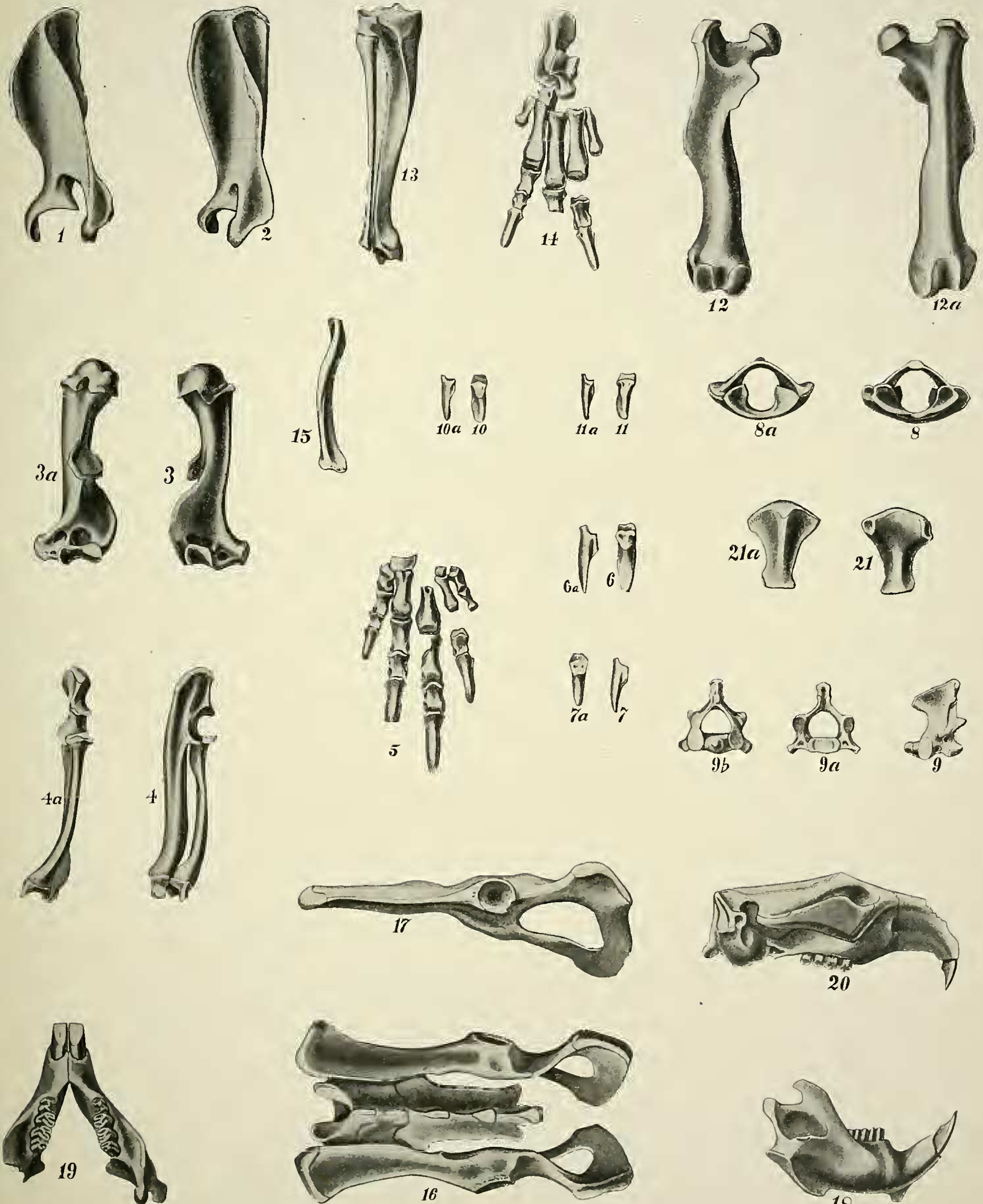
Sydney Prentice, del.

Fossil Rodents from the Upper Miocene, Harrison Beds. All Figures Natural Size.

EXPLANATION OF PLATE XVIII.

Fig. 1. *S. fossor*, type. External view of scapula.
Fig. 2. *S. fossor*, cotype. External view of scapula.
Fig. 3. *S. fossor*, type. Posterior view of humerus.
Fig. 3*a*. *S. fossor*, type. Anterior view of humerus.
Fig. 4. *S. fossor*, type. Internal view of radius and ulna.
Fig. 4*a*. *S. fossor*, type. Anterior view of radius and ulna.
Fig. 5. *S. fossor*. Dorsal view of manus. Composite.
Fig. 6. *S. fossor*. Plantar view of ungual phalanx, third digit of manus.
Fig. 6*a*. Side view of same phalanx.
Fig. 7. *S. fossor*. Side view of phalanx, second digit of manus.
Fig. 7*a*. Plantar view of same bone.
Fig. 8. *S. fossor*, type. Posterior view of atlas.
Fig. 8*a*. *S. fossor*, type. Anterior view of atlas.
Fig. 9. *S. fossor*, cotype. Side view of axis and third cervical showing coössification.
Fig. 9*a*. *S. fossor*, cotype. Posterior view of axis.
Fig. 9*b*. Anterior view of same bone.
Fig. 10. *S. fossor*, type. Plantar view of ungual phalanx, fourth digit of pes.
Fig. 10*a*. Side view of same bone.
Fig. 11. *S. fossor*, type. Plantar view of ungual phalanx of pes.
Fig. 11*a*. Side view of same bone.
Fig. 12. *S. fossor*, type. Posterior view of left femur.
Fig. 12*a*. Anterior view of same.
Fig. 13. *S. fossor*, type. Anterior view of tibia and fibula.
Fig. 14. *S. fossor*, type. Dorsal view of pes.
Fig. 15. *S. fossor*, cotype. An oblique view of right clavicle.
Fig. 16. *S. fossor*, type. Superior view of pelvis.
Fig. 17. *S. fossor*, type. View of left side of pelvis.
Fig. 18. *S. barbouri*, type. Side view of right mandible.
Fig. 19. *S. barbouri*, type. Crown view of inferior dentition.
Fig. 20. *S. barbouri*, type. Side view of skull.
Fig. 21. *S. fossor*, cotype. Superior view of presternum.
Fig. 21*a*. *S. fossor*, cotype. Inferior view of presternum.

All figures natural size.



Sydney Prentice, del.

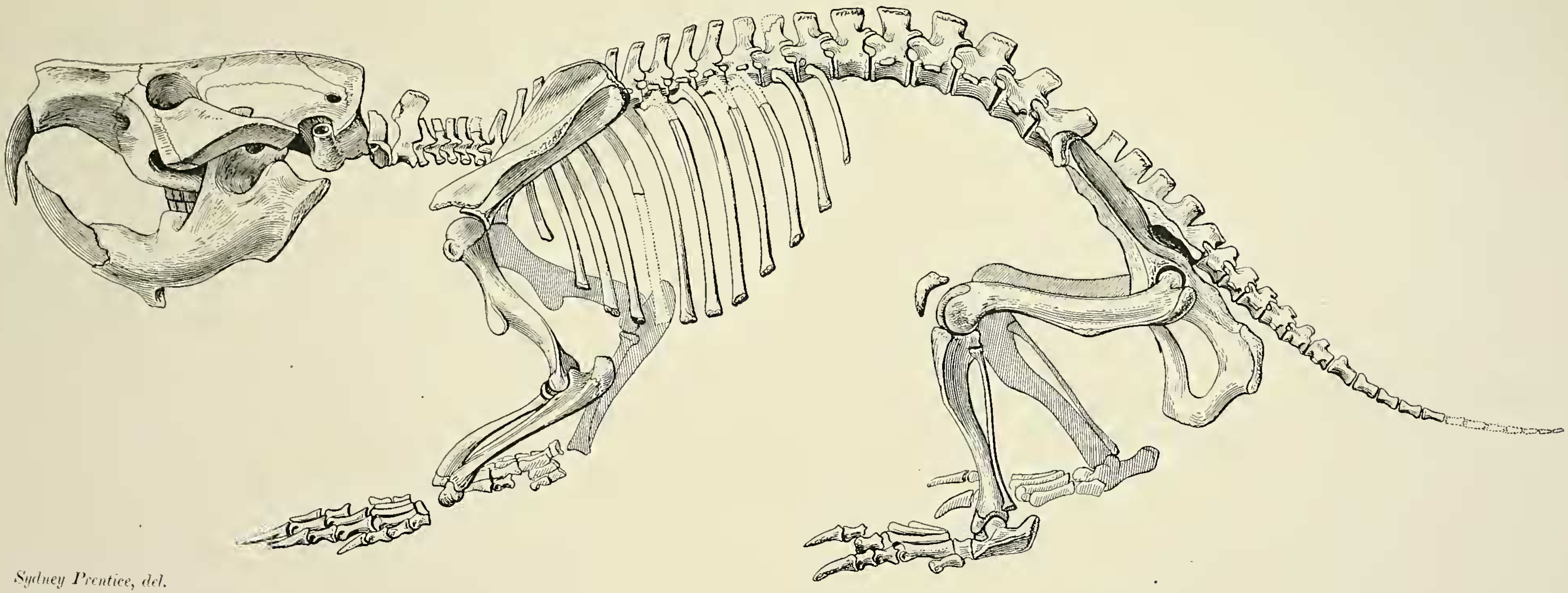
FOSSIL RODENTS FROM THE UPPER MIOCENE, HARRISON BEDS. ALL FIGURES NATURAL SIZE.

EXPLANATION OF PLATE XIX.

S. fossor, type 1217. Restoration of the skeleton.

The scapula is drawn from the cotype No. 1208 and the greater part of the fore-foot from specimen No. 1204.

The figure is approximately $\frac{3}{4}$ natural size.



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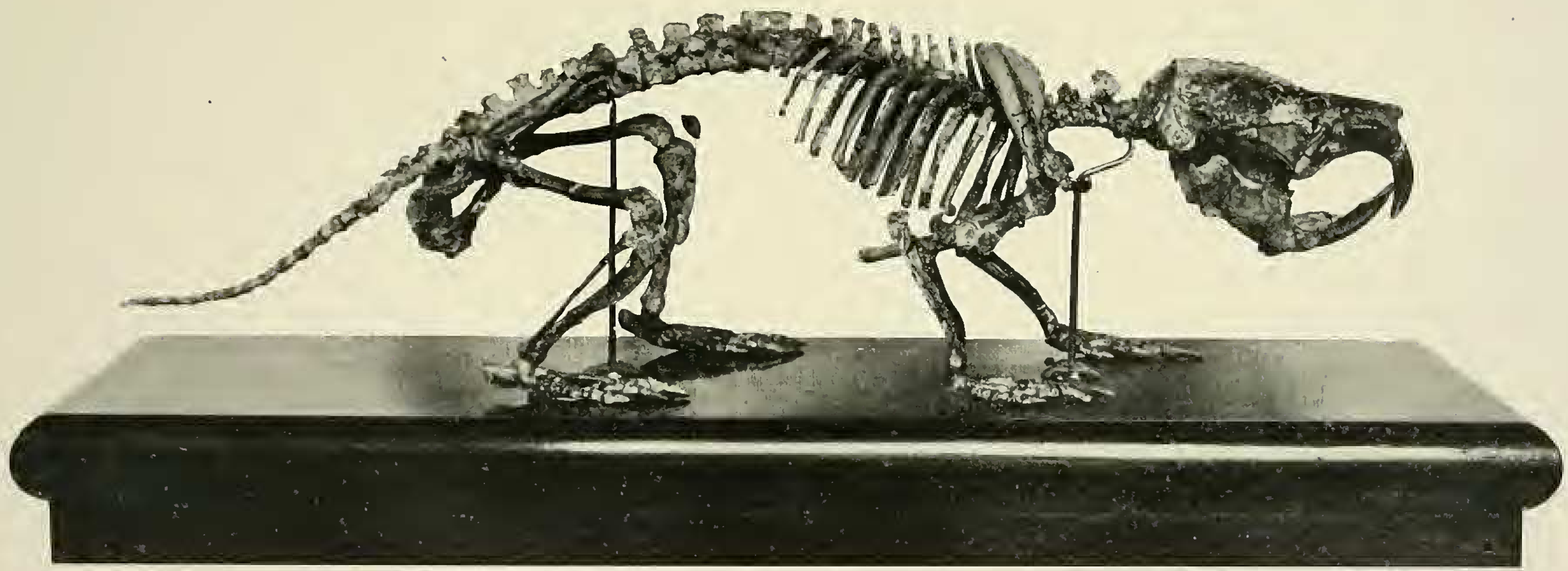
RESTORATION OF *STENEOFIBER FOSSOR.* $\frac{3}{4}$ NATURAL SIZE.

EXPLANATION OF PLATE XX.

Steneofiber fossor, type 1217. Mounted skeleton $\frac{4}{7}$ natural size. The greater part of the right fore-foot is from specimen No. 1204. Part of the sternum, the superior part of the left seapula, the left fore-foot, the greater part of the left hind-foot, and the tip of the tail, are reproduced in plaster of paris.



MOUNTED SKELETON OF *STENEOFIBER FOSSOR*. ABOUT $\frac{4}{7}$ NATURAL SIZE.

EXPLANATION OF PLATE XXI.

Fig. 1*a*. Section from *Dæmonelix* showing fossilized root remains. Two small rootlets with root-hairs, *h*, grew into the cavity formed by the decomposition of a larger root. *r*, bundle sheath enclosing the outer portion of the vascular bundle. × 65. (Eighth ring from bottom, *Dæmonelix* 17. Harrison Beds, Sioux Co., Nebraska.)

Fig. 1*b*. Cross-section of rootlet as usually found in *Dæmonelix*. Only the epidermal and cortical tissues are preserved. × 65. (Transverse section of *Dæmonelix* cake (late Miocene). Upper Monroe Creek Beds, Sioux Co., Neb.)

Fig. 2. Longitudinal section of rootlet showing epidermal tissue and, *h*, root-hairs. × 65. (Section from Ring 4, *Dæmonelix* 17. Taken close to the surface of specimen.)

Fig. 3. Cross-section of rootlet showing the stele or vascular bundle, *s*, and sand grains, *p*. × 65. (From the interior of Ring 8, *Dæmonelix* 17.)

Fig. 4. Cross-section of central portion of root showing the bundle sheath, *c*, with vascular tissue inside and cortical tissue outside. × 65. (Ring 12, *Dæmonelix* 17.)

Fig. 5. Longitudinal section of root showing the method of branching. × 31. *s*, stele. (Longisection of *Dæmonelix* "cake" from near its edge (late Miocene), Upper Monroe Creek Beds, Sioux Co., Neb.)

Fig. 6. Section taken longitudinally and including a bend in the root. *s*, stele. × 50. (Section taken parallel to the surface of "rhizome" of *Dæmonelix* 17. Harrison Beds, Sioux Co., Neb.)

Fig. 7. Portion of same showing part of the stele at a greater magnification. *w*, tracheary vessels or wood cells. × 275.

Fig. 8. Portion of same stele still more enlarged. *c*, cortical cells; *b*, bundle sheath; *x*, reticulated wood vessel. × 400.

Fig. 9. Section from fragment of an older root showing a regular superimposition of the cortical cells, *c*. × 65.

Fig. 10. Cross-section in same fragment showing, *w*, woody tissue and, *c*, cortex. × 65.

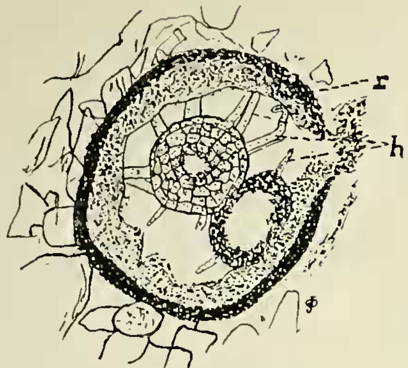


Fig. 1a.

Fig. 1b.

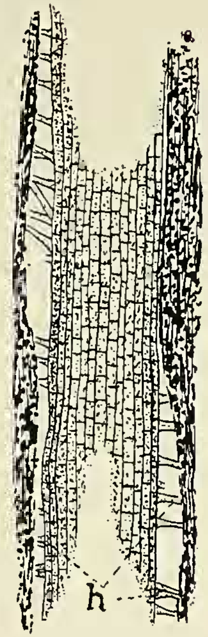


Fig. 2.

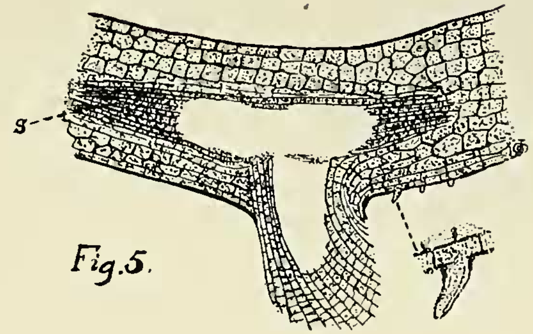


Fig. 5.

Fig. 6.

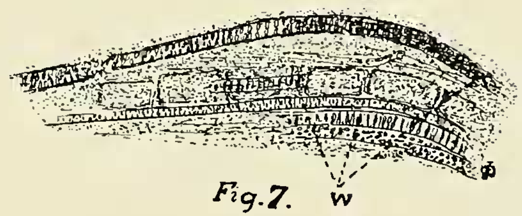


Fig. 7.

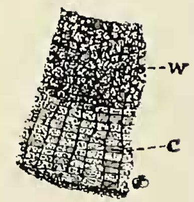


Fig. 10.

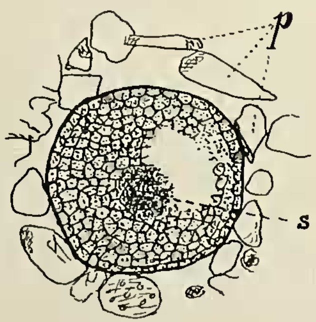


Fig. 3.

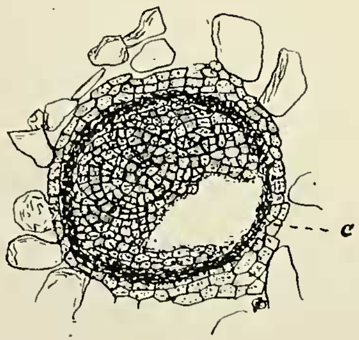


Fig. 4.

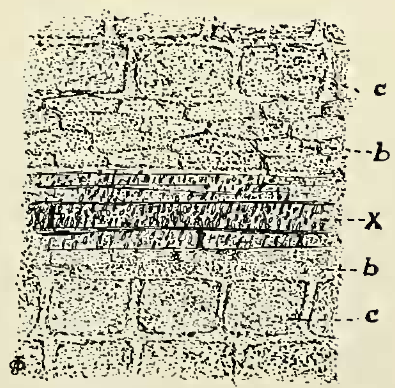


Fig. 8.

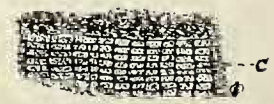


Fig. 9.

O. E. Jennings, del.

MICROSCOPIC SECTIONS OF CELLULAR STRUCTURES IN *DÆMONELIX*. GREATLY MAGNIFIED.